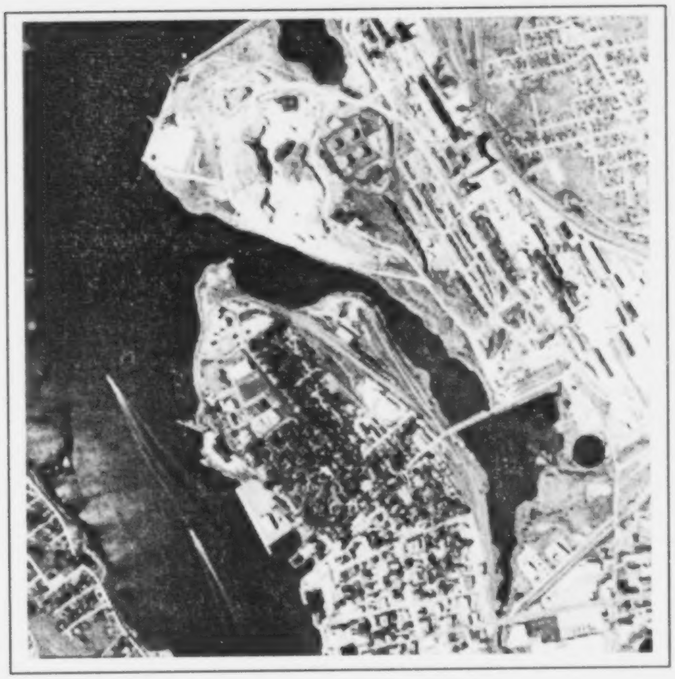

REMEDIATION OF THE SYDNEY TAR PONDS AND COKE OVENS SITES

PROJECT DESCRIPTION

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December 2004

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DEFINITIONS

biochemical oxygen demand	A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water.
bioremediation	The treatment of pollutants or waste (as in an oil spill, contaminated groundwater, or industrial process) by the use of microorganisms (as bacteria) that break down the undesirable substances.
chlorobenzene	A colorless flammable volatile toxic liquid C_6H_5Cl used in organic synthesis (as of DDT) and as a solvent.
CCME	Canadian Council of Ministers of the Environment: A Canadian advisory group that develops environmental guidelines.
COC	Chemicals of Concern: chemicals selected from the screening of all chemicals found during the site investigations that may be a hazard.
cofferdam	A watertight enclosure from which water is pumped to expose the bottom of a body of water and permit construction (as of a pier).
contamination	Introduction into water, air, and soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use. Also applies to surfaces of objects, buildings, and various household and agricultural use products.
criteria	A generic term used in this study to mean regulations, guidelines, objectives, and standards.
DRE	Destruction Removal Efficiency: A percentage that represents the amount of a compound removed or destroyed in an incinerator relative to the amount entering the system (e.g., a DRE of 99.9999 percent means that 999,999 molecules are destroyed for every 1,000,000 that enter).
EA	Environmental Assessment: An environmental analysis prepared pursuant to the Federal or Provincial legislation to determine whether an action would significantly affect the environment.
EMP	Environmental Management Plan: A plan that addresses the potential impacts created during a construction or demolition period. An EMP provides a management structure for the reporting and controlling of a project's environmental impacts. An EMP comprises a number of sub-plans, each addressing a particular environmental aspect that could result in potential impacts.

fauna	The animal life of a region or geological period.
flora	Plant or bacterial life forms of a region or geological period.
guideline	A numerical concentration or narrative statement that is recommended as an upper limit to protect and maintain a specified use of air, water, sediment, soil, or wildlife. Guidelines are not legally binding.
hectare	A measure of area (100m X 100m).
hydrocarbons	Chemical compounds that consist entirely of carbon and hydrogen.
impervious	Not allowing entrance or passage (i.e., impenetrable).
inorganic	In chemistry, any compound not containing carbon.
JAG	Joint Action Group on the Environmental Cleanup of the Muggah Creek Watershed.
kg	Kilogram: A measure of weight (one thousand grams).
landfarming	A remediation method in which hazardous materials or waste present or deposited on or in the soil is degraded naturally by microbes.
m^3	Cubic metre: A measure of volume (1m X 1m X 1m).
mg	Milligram: A measure of weight (one thousandth of a gram).
microorganism	Any form of animal or plant not visible to the naked eye.
nitrate	A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water.
NSDEL	Nova Scotia Department of the Environment and Labour
organic	In chemistry, any compound containing carbon.
PAH	Polycyclic Aromatic Hydrocarbon: A chemical formed by the incomplete burning of organic materials such as wood or fossil fuels.
PCB	Polychlorinated Biphenyl: Any of several compounds that are produced by replacing hydrogen atoms in biphenyl with chlorine. Environmental pollutants which tend to accumulate in animal tissues. Commonly used in various industrial applications such as electrical transformers to insulate and transfer heat.

PCB incinerator	A treatment technology involving destruction of PCB waste by controlled burning at high temperatures.
PCDDs and PCDFs	Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans: highly persistent chlorinated hydrocarbon compounds with a strong affinities for sediments and a high potentials for accumulating in biological tissues.
PPE	Personal Protective Equipment: Equipment used to protect employees from the risk of injury by creating a barrier against workplace hazards (e.g., helmets, respirators).
regulation	A rule of law that is set down in order to govern an area or people. Regulations are enacted in Canada and the US by the provincial/state and federal governments.
remediation	Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a contaminated site.
residual	Amount of a pollutant remaining in the environment after a natural or technological process has taken place (e.g., the sludge remaining after initial wastewater treatment).
solidification/stabilization	Removal of wastewater from a waste or changing it chemically to make it less permeable and susceptible to transport by water.
SSTL	Site Specific Target Level: Cleanup target levels calculated for specific sites based on contaminant characteristics, concentrations, and site use.
STPA	Sydney Tar Ponds Agency.
subaqueous	Underwater.
USEPA	United States Environmental Protection Agency.
VOC	Volatile Organic Compound: An organic substance containing carbon that easily mixes with the air.
µg	Microgram: a measure of weight (one millionth of a gram).

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EXECUTIVE SUMMARY

The governments of Canada and Nova Scotia propose to remediate the Sydney Tar Ponds and Coke Ovens sites. The Sydney Tar Ponds Agency (a Special Operating Agency of the government of Nova Scotia) will manage and implement the project.

Purpose of the Project Description

The proposed remediation plan will undergo an environmental assessment required by the Canadian Environmental Assessment Act and the Nova Scotia Environment Act. This document, known as the project description, serves two important functions in the federal environmental assessment process: 1) to determine the need for an environmental assessment; and 2) to promote efficient coordination of the environmental assessment.

Background Information

The Coke Ovens is a 68 hectare former industrial property bounded by residential and former industrial lands. It contains several watercourses including Coke Ovens Brook. From 1901 to 1988, various coke production plants operating on the site provided carbon and fuel for a nearby steel mill. Other industrial plants on the property used by-products from the coking operations to manufacture various commercial products. An estimated 560,000 tonnes (280,000 m^3) of soil on the Coke Ovens is contaminated with petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), and metals. An additional 1,300 tonnes (1,000 m^3) of PAH contaminated sediment is present in Coke Ovens Brook and 25,000 (12,500 m^3) tonnes of contaminated soil is present in the in-ground tar cell.

For the purposes of the proposed cleanup, the Coke Ovens site also includes the Coke Ovens Brook Connector, a 4.1 hectare corridor containing the portion of Coke Ovens Brook that runs between the Coke Ovens and the South Tar Pond.

The Tar Ponds (consisting of the North Tar Pond and the South Tar Pond) is the common name for Muggah Creek, a tidal estuary that received industrial discharges from upstream industrial activities, including the Coke Ovens. The Tar Ponds cover 31 hectares and contain more than 700,000 tonnes (550,000 m^3) of sediments contaminated with PAHs and metals. About five percent of the sediments also contain polychlorinated biphenyls (PCBs) in amounts greater than 50 parts per million.

Proposed Remediation Strategy

Environment Canada and the Sydney Tar Ponds Agency developed the proposed cleanup plan, drawing on hundreds of engineering and scientific studies, and on public consultations carried out since 1996. The remediation strategy consists of several components:

- controlling surface water (at the Tar Ponds and Coke Ovens) and groundwater (at the Coke Ovens);
- removing and destroying selected contaminants from both sites;
- treating in-place selected contaminants at both sites
- containing remaining contaminants at both sites;

- site surface restoration and landscaping at both sites; and
- developing long-term monitoring and maintenance plans for both sites

Details are provided below of the proposed remediation strategies for the Tar Ponds and Coke Ovens sites.

Tar Ponds

Control Water – Watercourse diversion channels will redirect surface water flowing through the Tar Ponds. This will isolate brooks and streams from contaminated Tar Ponds sediments.

Remove and Destroy Selected Contaminants – 120,000 tonnes (92,000 m^3) of PCB sediments and surrounding sediments will be excavated or dredged, dewatered, then destroyed in an approved, temporary PCB incinerator that will be set up off-site.

Treat Selected Contaminants In-place – The top 1 to 2 m of remaining sediments will be solidified and stabilized in-place with a binder, such as Portland cement, using augers or grout injection systems.

Contain Residual Contaminants – A containment system will be designed and constructed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability barrier walls, installed at various locations around the perimeter of the Tar Ponds, and an engineered cap.

Site Surface Restoration and Landscaping – The site surfaces will be restored and landscaped in a manner compatible with natural surroundings and future site use(s).

Long-term Monitoring and Maintenance Plan – A long-term monitoring and maintenance plan will be developed for the site. Air quality, water quality, sediment, biota, and the performance of the containment system will be monitored for 25 years after completion of the project.

Coke Ovens

Control Water – Diversion channels and barrier walls will be installed to reroute groundwater and surface water flowing through the site. This will facilitate the removal and cleanup of contaminated materials, prevent contamination of surface water, and minimize water treatment requirements.

Remove and Destroy Selected Contaminants – 1,300 tonnes (1,000 m^3) of PAH contaminated sediment from Coke Ovens Brook and 25,000 tonnes (12,500 m^3) of PAH contaminated material from the in-ground tar cell will be removed and destroyed in an approved, temporary incinerator that will be set up off-site.

Treat Selected Contaminants In-place – 253,700 tonnes (128,800 m^3) of the remaining surface soils contaminated with petroleum hydrocarbons and PAHs will be treated in-place using landfarming, a form of bioremediation. Landfarming of the top 0.5 m of contaminated soil will be used to promote biological breakdown of contaminants in the surface soils.

Contain Residual Contaminants – A containment system will be designed and constructed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability vertical walls installed at various locations around the perimeter of the Coke Ovens and a soil cover designed to facilitate future site use(s).

Site Surface Restoration and Landscaping – Site surfaces will be restored and landscaped in a manner compatible with natural surroundings and future site uses.

Long-term Monitoring and Maintenance Plan – A long-term monitoring and maintenance plan will be developed for the site. Air quality, water quality, soil, and the performance of the containment system will be monitored for 25 years after completion of the project.

Schedule

It is estimated that remediation of both sites will take 10 years to complete. The general schedule for completing the various components of the cleanup is as follows:

Engineering Design	2004 to 2006
Environmental Assessment	2004 to 2006
Eliminate PCBs	2006 to 2010
Eliminate Tar Cell & Coke Ovens Brook	2006 to 2010
Cleanup & Cap Tar Ponds	2006 to 2013
Cleanup & Cap Coke Ovens	2006 to 2013
Decommission Facilities	2013

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1.0 INTRODUCTION

The Government of Canada and the Government of Nova Scotia, through the Sydney Tar Ponds Agency, intend to remediate (i.e., cleanup) the Sydney Tar Ponds and Coke Ovens sites located in Cape Breton Regional Municipality (CBRM), Nova Scotia. The general location of the sites is shown in Figure 1.1. Figure 1.2 shows the general features of the proposed project area.

Remediation of the sites will reduce the ecological and human health risks from the existing contamination.

1.1 PURPOSE OF THE PROJECT DESCRIPTION

The purpose of this document is to provide a project description for the remediation of the Sydney Tar Ponds and Coke Ovens sites.

As described in the document "Preparing Project Descriptions under the *Canadian Environmental Assessment Act*" (August 2000 - OPS - EPO/5 – 2000), a Project Description serves 2 important functions in the federal environmental assessment process: 1) to determine the need for an Environmental Assessment; and 2) to promote efficient coordination of the Environmental Assessment.

The project description might also sometimes be used as an internal and external communications tool to 1) identify responsible authorities within the federal government and 2) to communicate information to the general public.

This document provides a detailed description of the proposed project activities to facilitate the review requirements of the Canadian Environmental Assessment Agency, as well as the review by other regulating authorities. The Project Description will also be included as part of any required Environmental Assessment report.

1.2 LAYOUT OF THE PROJECT DESCRIPTION REPORT

This report presents the Project Description of the Remediation of the Sydney Tar Ponds and Coke Ovens sites. The report includes the following major elements:

- Definitions – definition of terms used throughout the Project Description report;
- Executive Summary;
- Section 1.0 – Introduction – background information on the process used to select the proposed remediation methods, previously completed studies and physical works at the sites, and proposed preventative works to be completed to reduce, with or without the remediation project, the potential for contaminant migration off the sites;
- Section 2.0 – Environmental Description – a description of the biophysical, socio-economic, and regulatory environments surrounding the Tar Ponds and Coke Ovens sites;
- Section 3.0 – Proposed Remediation of the Tar Ponds – a detailed description of the physical works to be completed during remediation of the Tar Ponds;

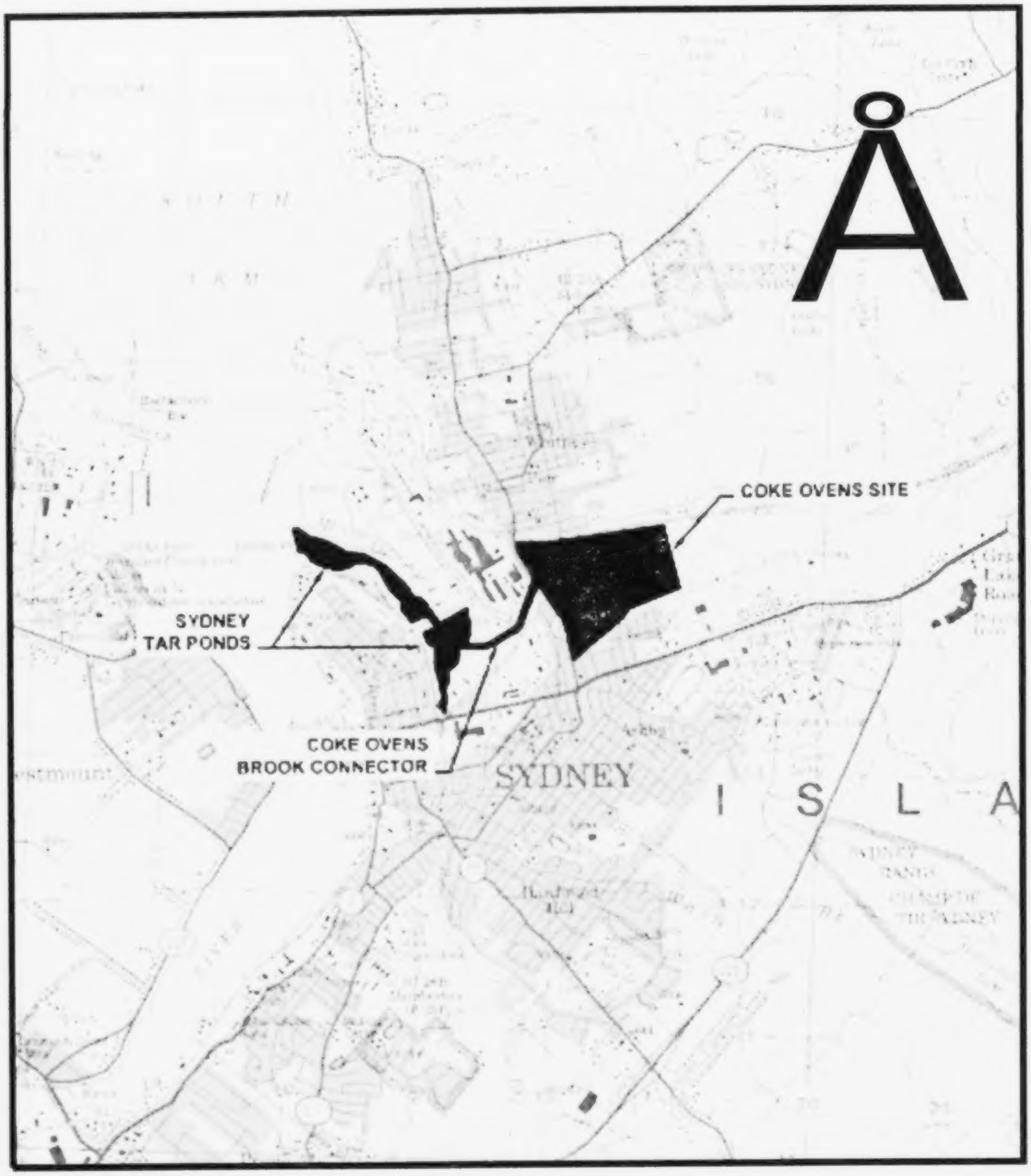
COKE OVENS SITE
SYDNEY
TAR PONDS
COKE OVENS
BROOK CONNECTOR
SYDNEY
I S L A
estmount

Figure 1.1

General Project Site Location

Project Description
Sydney Tar Ponds and Coke Ovens Site

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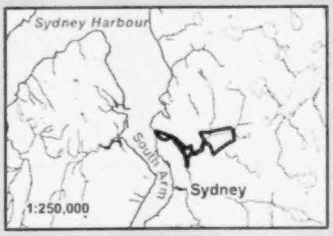
Sydney Harbour
South Arm
Sydney
1:250,000

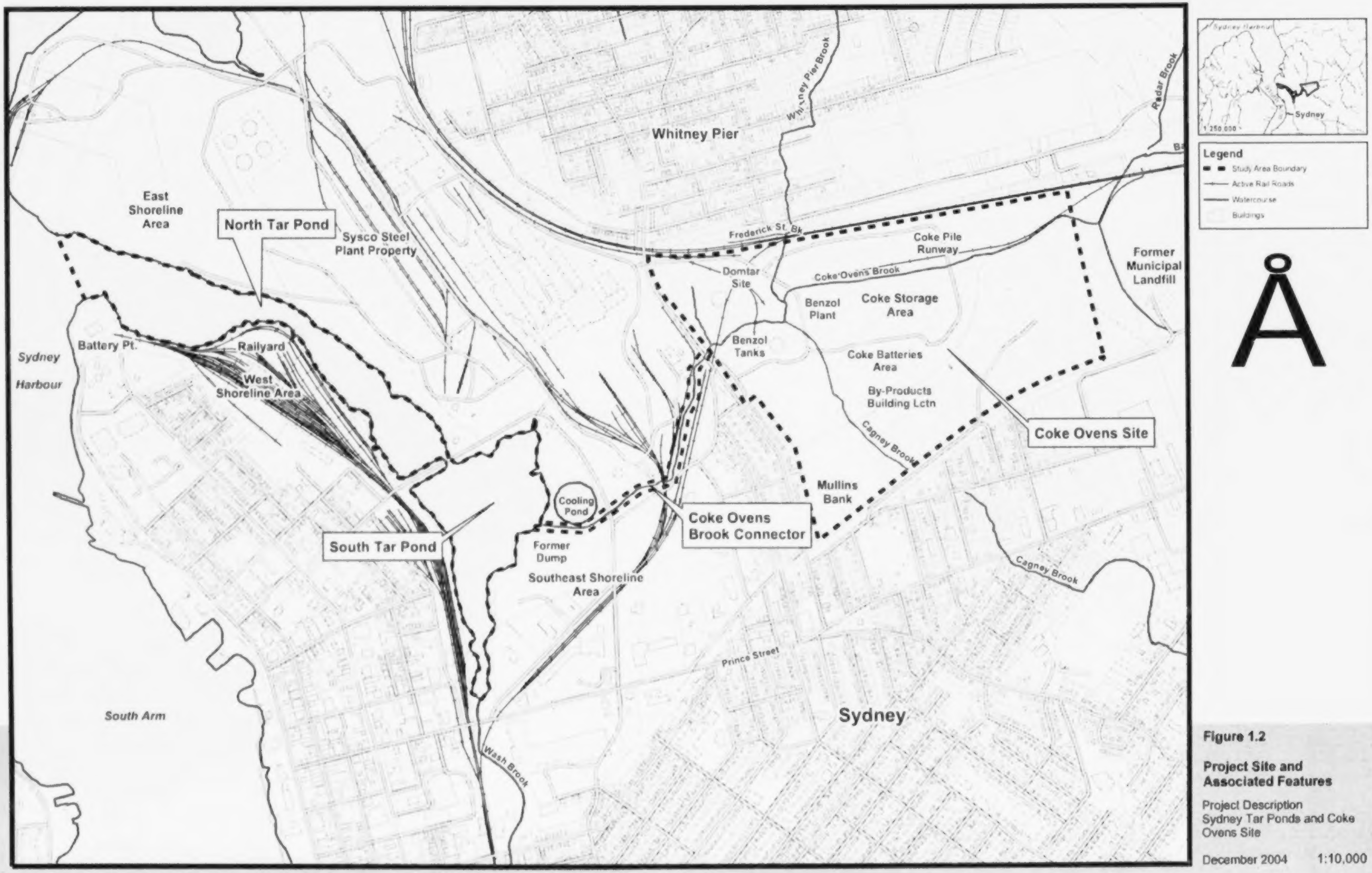
Whitney Pier
Whitney Pier Brook
Radar Brook
Frederick St. Bk
East Shoreline Area
North Tar Pond
Sysco Steel Plant Property
Domtar Site
Coke Pile Runway
Coke Ovens Brook
Benzol Plant
Coke Storage Area
Former Municipal Landfill
Battery Pt.
Railyard
Sydney
Harbour
West Shoreline Area
Benzol Tanks
Coke Batteries Area
By-Products Building Lctn
Cagney Brook
Coke Ovens Site
Cooling Pond
Mullins Bank
Coke Ovens Brook Connector
South Tar Pond
Former Dump
Southeast Shoreline Area
Prince Street
South Arm
Wash Brook
Sydney
Sydney Harbour
Sydney
1:250,000
Legend
Study Area Boundary
Active Rail Roads
Watercourse
Buildings

Figure 1.2

Project Site and Associated Features

Project Description
Sydney Tar Ponds and Coke Ovens Site

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- Section 4.0 – Proposed Remediation of the Coke Ovens – a detailed description of the physical works to be completed during remediation of the Coke Ovens;
- Section 5.0 – Proposed Incineration of Contaminated Materials – a description of the proposed incineration of contaminated materials from the Tar Ponds and Coke Ovens sites;
- Section 6.0 – References;
- Appendix A – A copy of the Federal/Provincial Memorandum of Agreement for the Remediation of the Sydney Tar Ponds and Coke Ovens Sites;
- Appendix B – A copy of the Destruction Technology Siting Study; and
- Appendix C – A copy of the Environmental Management Plan for the project.

A virtual tour of the remediation project is provided on a DVD contained in a pocket at the back of the report.

1.3 CONTACTS REGARDING THE PROJECT DESCRIPTION

The remediation project will be cost-shared between the Government of Canada and the Province of Nova Scotia. Contacts for the 2 governments are as follows:

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1.4 BACKGROUND INFORMATION

The background information provided in Sections 1.4 to 1.6 is based on information contained in the Remedial Action Evaluation Reports (RAER) for the Tar Ponds and Coke Ovens sites prepared by CBCL/ENSR in 2003.

Located in the heart of the CBRM, the landscape of the Muggah Creek Watershed and its estuary includes a recently closed steel making operation, the remains of a coke production facility, a rail yard, and a number of active and abandoned waste material dumps.

Many of the production activities associated with the early coal and steel industry used raw materials, or produced wastes that can cause adverse effects for human health and the environment. In general, during these earlier times, little was known of the negative effects of industrial pollution, which was considered to be a necessary by-product of prosperity.

The industrial by-products of the Sydney coke production operations included coal tar, ammonia, sulphur, light hydrocarbons (benzene, xylene, toluene), and polycyclic aromatic hydrocarbons (PAHs). In the early years of coke production, the contribution of contaminants to the environment was reduced through the internal recycling and recovery of these by-products. As the demand for these materials diminished, recycling and recovery operations were no longer economically viable. Formerly valuable by-products became waste materials and were allowed either to accumulate in unsecured storage areas at the plant site, or were deposited directly onto the soil, or into site watercourses. As a result of these activities, contaminants contained in the raw materials and wastes are now present in the soils and groundwater of the Coke Ovens site, and in the waters and sediments of the Tar Ponds, Coke Ovens Brook, Muggah Creek and Sydney Harbour.

The environments of Muggah Creek and Sydney were also impacted by the by-products of the steel making process, which included huge quantities of the relatively inert waste material known as *slag*. Over the last century of operation of the steel plant, slag and waste iron were deposited as infill material along the northeastern shoreline of the Muggah Creek estuary and Sydney Harbour. Over time the infilling operations encroached upon the former salt marsh and greatly changed the configuration of the natural shoreline. Other sources of contaminants associated with the coal and steel industry that may have impacted the Tar Ponds include the raw coal and coke product, flue dust from the blast furnaces and ovens, coal tars, sulphur (from the sulphuric acid plant), and miscellaneous waste water effluents.

The steel and coke industry was not the only industry operating in this area of Sydney. There was, for example, a coal tar plant, a cement plant, an asphalt paving company, a fuel gas and oil company, metal processors, and a brick manufacturing company located in or in proximity to this area. Any or all of these operations may also have contributed to the contaminants in the area's soils, sediments, surface and groundwater, and air.

After nearly 100 years of coal and steel production, environmental contamination of the Muggah Creek watershed in and around the area of former steel and coke making operations is known to be extensive and complex. Government and community efforts towards the remediation of impacted lands and water within the watershed have focused primarily on 4 areas (JAG, 1998):

- the North and South Ponds of the Muggah Creek (the Tar Ponds);
- the former Coke Ovens site;
- the Coke Ovens Brook Connector (a tributary to Muggah Creek); and
- the former municipal landfill.

This area, including the Tar Ponds and Coke Ovens sites, has been referred to as one of the worst contaminated sites in Canada (JAG, 1998).

1.4.1 Historical Data and Studies

Although most of the assessment of environmental conditions in the Muggah Creek Watershed has taken place in the past decade, environmental investigations of the area were initiated as early as 1980. The following sections provide a brief summary of critical investigations and activities and note the important findings, conclusions, and recommendations.

In 1980, Environment Canada (EC) examined effluent discharges from operations of the Sydney Steel Corporation (SYSCO), which at that time included both the steel plant and coke ovens. Although only a limited list of chemical parameters were assessed, elevated levels of ammonia, phenol, cyanide, sulphide and thiocyanate were reported in effluent streams from the Coke Ovens. (EC, 1981).

Environment Canada subsequently undertook a review of existing data on pollution sources and effects in Industrial Cape Breton (EC, 1983). The study identified linkages between the then current, as well as historic, operations of the steel and coke plants and evidence of industrial pollution in Sydney Harbour; elevated levels of PAHs were noted as being a particular concern.

During the more detailed evaluation of PAH contamination in Sydney Harbour, efforts were made to further delineate the extent and sources of elevated PAHs in the Harbour. The Study identified the North and South Ponds (Tar Ponds) of Muggah Creek as the only significant source of PAH release to the Harbour. Coal tar distillates produced by coking operations on the Coke Ovens site were identified as the most significant contributor of PAH to the Tar Ponds, *via* the Coke Ovens Brook.

1.4.1.1 Early Remediation Plans (1984-1994)

This early acknowledgement of contamination in Muggah Creek, and its ramifications for Sydney Harbour, led to the implementation of a program for remediation of the Tar Ponds.

In 1984, Acres International Limited undertook a review of the existing data, proposed and conducted additional data collection, and recommended a remediation plan that focused primarily on the PAH contaminated sediment of the Tar Ponds (Acres, 1984). Data included in the Acres report further defined the concentrations, depths, and quantities of contaminated sediments, the hydraulic conditions in the Ponds, and the relationships of the movements of PAH and Total Suspended Solids within the area. Analysis of sediment samples demonstrated consistently elevated levels of PAHs, together with considerable calorific value. Acres estimated that there were 700,000 yd^3 (i.e., >535,500 m^3) of contaminated sediments in thicknesses of up to 3 m in the Tar Ponds.

A preliminary environmental screening undertaken for the proposed Tar Ponds remediation project (EC, 1986) described the planned cleanup and discussed the potential for PAH releases. The proposed cleanup methodology included the creation of steel sheet-piled containment cells within the Tar Ponds. Sediments would be excavated from inside these containment cells and transferred to a boiler site for de-watering and mixing with an auxiliary fuel. The decanted water would be filtered through carbon (coal) before release to the environment. The coal used as filter material would eventually be used to fuel the boiler. Excavated areas would be filled with a combination of boiler ash and inert slag from the steel plant operations. Because it was anticipated that continued inputs of PAHs to the Tar Ponds would occur from the Coke Ovens site, all surface water from Coke Ovens Brook would be first treated with a coal filter prior to its release to the Tar Ponds. Boiler emissions and all liquid effluent streams would be monitored for Contaminants of Concern (COCs).

In 1988, Acres also reviewed waste incineration processes for the purpose of selecting one for the Tar Ponds Remediation (Acres, 1988a). They described the Tar Ponds sediment as a low-grade fuel because of its high moisture and ash content. In this 1988 study, Acres determined that the calorific value of the contaminant sediment materials was, as expected, related to the ash content; it exhibited an average value of about 20.9 MJ/kg (9,000 Btu/lb) (dry weight). This study also noted the following:

- PAHs concentrations averaged about 7,000 mg/kg, but generally declined with depth and towards the downstream areas of the Ponds;
- The PAH compounds, naphthalene and phenanthrene, accounted for 60 to 80% of the total content of PAHs in the samples;
- Concentrations of Heterocyclic Nitrogeneous Compounds (HNCs) were less variable than those of PAHs, but generally occurred at levels that correlated with PAHs levels; and

- Of the heavy metals known to occur in the sediments, concentrations of zinc were the most abundant, followed by lead, copper, arsenic and chromium.

In a study of hydrogeological conditions (Acres, 1988b), Acres International Limited reported that a large part of the Coke Ovens Brook watershed (within the site) was contaminated with organic chemicals derived from past coking operations. Acres suggested that the remediation of the Tar Ponds would eliminate only 25% of the PAHs released to Sydney Harbour. The remaining 75% was believed to originate from contaminated surface water inflows from the Coke Ovens Brook. Although it is believed that the 1988 study was based on data obtained following the closure of the Coke Ovens, it is not clear in their report, whether contamination of the Coke Ovens Brook was ongoing at that time.

In 1990, Nolan Davis & Associates and Jacques Whitford & Associates (NDAL/JWA, 1990) undertook a comprehensive investigation of the Coke Ovens Brook area to further delineate groundwater contamination. This study revealed much about the sources and extent of the various types of contamination and their pathways. It was noted that contamination from coal tar, PAHs, HNCs and acid drainage could continue to migrate from the Coke Ovens site to Muggah Creek through both surface and groundwater pathways, even after the Tar Ponds were cleaned up. The main findings of this study can be summarized as follows:

- the dominant direction of groundwater contaminant plume movement from the Coke Ovens site was toward Coke Ovens Brook and westerly towards the lands of the steel plant;
- the extensively weathered and fractured bedrock surface appeared to act as an underdrain for local groundwater flow and was considered to be the critical contaminant release pathway;
- most of the overburden in the area was contaminated with various organic compounds to the top of the bedrock surface;
- the concentrations of organic compounds in the soils decreased with depth and was greater in the till than the bedrock;
- the Domtar site had the highest concentrations of PAHs, HNC and phenol;
- shallow groundwater in the area of the Benzol plant was contaminated with lighter organic compounds and light non-aqueous phase liquids (LNAPLs), such as benzene and naphthalene;
- the coal storage areas were minor sources of organic contamination, but were the historic source of acid drainage;
- plumes of groundwater contaminated with organic chemicals were not moving any appreciable distance north or south towards populated areas; and
- along the northeast shore of the Tar Ponds, there was a layer of coal or coal tar derived materials that could contain organic contaminants between the layers of infilled slag and the underlying till.

In 1989, Acres undertook an investigation of the southeastern shorelines of the Tar Ponds to identify areas of potential contamination that may have been covered by infilling (Acres, 1989). Soil samples of the fill materials from boreholes drilled adjacent to the Tar Ponds (north of Prince Street) contained coal, slag and other materials. Contamination similar to that experienced in Tar Ponds sediments was found in these boreholes at depths below sea level, indicating that infilled areas were originally part of Muggah Creek that were filled and covered over time. Soils sampled from the boreholes drilled in the area (south of Prince Street) contained compact fill composed of fine slag, concrete fragments and coal particles. One of the 3 boreholes encountered a contaminated layer that was considered an upstream extension of the Tar Ponds. This study concluded that the contaminated material was mostly confined to the formerly open area of the Tar Ponds and that the natural underlying zone and the overlying fill were uncontaminated.

During a second shoreline study (Acres, 1990a), 26 boreholes were drilled and 3 monitoring wells were installed. Relevant conclusions from these investigations were:

- the original shoreline of the Tar Ponds was redefined in several areas;
- in infilled areas of the Ponds' shorelines, the underlying material is typically contaminated;
- soils along the northeast shoreline of the North Pond and the southeast shoreline of the South Pond near Coke Ovens Brook recorded the highest levels of contaminants (this latter area is the site of a former municipal solid waste dump);
- the southeast shoreline of the South Pond (behind the bus terminal) does not have underlying contaminated sediment;
- the southwest shoreline of the North Pond (rail yard) and the area east of Wash Brook (shopping mall) has underlying material that is less contaminated than other areas; and
- the underlying sediments in the area of the southwest shoreline of the South Pond are not contaminated.

A study undertaken by P. Lane Associates (Lane, 1991) examined contaminant transport from Muggah Creek to the Harbour. The study estimated that the influx of PAHs from Coke Ovens Brook to be 23 ±7 kg/year and the efflux of PAHs from the contaminated sediments of the Tar Ponds to Sydney Harbour to be 770 ±360 kg/year. Influx and efflux was believed to be affected by tidal and climatic conditions and freshwater runoff. The study also determined that sorting of some PAH compounds occurred as they were transported to the Harbour. The more soluble compounds, for example, were flushed out of Muggah Creek within 1 or 2 tidal cycles. Lower solubility compounds tended to be stored in the sediments and released to the Harbour primarily during high runoff events.

A later study on Coke Ovens Brook, (Washburn & Gillis, 1993) determined that the annual mass flow rate of PAHs was less than 64 kg/year just downstream of the Coke Ovens site. Its destination is not stated, but is assumed to be the Tar Ponds.

A study in 1990 (O'Halloran Campbell, 1990) evaluated excavation and backfill methods for the Tar Ponds and recommended that underwater dredging be used, following the construction of a cofferdam between the North and South Ponds at Ferry Street. The cofferdam was intended to reduce the potential of contaminants disturbed by the excavation to be released to the Harbour and to improve conditions for dredging operations in the South Pond. The cofferdam was designed to control flows from the South Pond to the North Pond either *via* an overflow weir, sluice gates, or a combination of the technologies (Acres, 1990b). The cofferdam was also intended to address the following:

- eliminate tidal fluctuations and reduce fluctuations caused by varying runoff, thereby lowering the outflow of sediments during excavation;
- permit short-term containment of outflows from the South Pond to prevent the further release of spilled or disturbed materials and to facilitate remediation;
- reduce water level fluctuations thus improving the effectiveness of silt curtains around the excavation;
- keep the water level high enough to enhance the settling of disturbed materials in the South Pond; and
- cover the area with water during excavation to reduce vapours and odours.

A second dyke was proposed for the mouth of Muggah Creek to facilitate dredging operations in the North Pond (O'Halloran Campbell, 1990).

In later reports prepared in support of the environmental permit application (Acres, 1991), the Tar Ponds remediation project was described as including the hydraulic dredging of the Tar Pond sediments, its transportation *via* pipeline to an incinerator, combustion of the contaminants, and the subsequent generation of electricity. The incinerator involved a revolving fluidized bed furnace tied into an existing boiler and turbine at SYSCO and was capable of generating up to 10 MW of power. Oil was to be used for furnace start-up, and coal was to be used as a supplementary fuel in the event the caloric value of the Tar Ponds Sediments was too low to ensure the efficient operation of the incinerator. The ash generated would be treated as required, combined with relatively inert slag material from SYSCO, and used to infill excavated areas of the Tar Ponds. Slag has long been used for roadbed construction and is considered to be an acceptable backfill material. It is described as hydrophobic, basic in character, alkaline in water, and resembling low grade Portland cement. Existing surface water flows would be channelized through the infilled areas of Muggah Creek, but a final plan for the infilled areas was not developed.

The Tar Ponds remediation project also included preliminary work on the cleanup of the Coke Ovens Brook and the Coke Ovens site, but activities in these locations were intended to be part of a longer-term project.

Concentrations of PCBs (i.e., polychlorinated biphenyls) in the Tar Ponds sediment were not a significant issue up to this point in the remediation project. Earlier testing had indicated that PCB concentrations were low or non-detectable (Acres, 1991). However, a routine sampling program undertaken in the South Pond during 1992 (Acres, 1993) found areas of PCB concentrations at levels greater than 50 ppm (subject to regulatory control). The highest concentrations of PCBs were detected adjacent to the outlet of a major sewer in the northeast corner of the South Pond where the single highest concentration of PCBs was over 2,000 ppm. The quantity of materials contaminated with elevated levels of PCBs was estimated to be approximately 4,800 m^3. At this time it was recommended that the PCB material be removed from the Pond and transported to an approved storage site.

An independent review of the Tar Ponds remediation project was undertaken by R.V. Anderson and Associates in 1994 prior to start-up and as a result of the findings on PCB contamination. Anderson's report (Anderson, 1994) included 2 significant conclusions. First, although the proposed equipment and processes for the remediation project were considered appropriate for the intended functions, concern was expressed about the ability of the dredging and pumping system to deliver the contaminated sediment to the incinerator. It was felt that any failure in the delivery system could jeopardize the cleanup process. Secondly, the capacity of the remediation project incineration system to adequately destroy PCBs was not known and would have to be tested and verified prior to start-up of the remediation project. Problems associated with the sediment pumping system, growing public concern over the proposal to incinerate PCB contaminated sediments at the site, and escalating project costs led to the cancellation of the Tar Ponds remediation project in 1994.

1.4.1.2 Containment Approaches to Remediation

Following cancellation of the excavation and incineration-based approach to cleanup, the Province, in 1995, issued a Request for Proposals for the management of the remediation of the Tar Ponds. As a result of this request, an alternative approach was proposed, based on containment of the contaminated sediments in the Tar Ponds. This *in situ* (i.e., in-place) approach to containment was intended to stabilize the PAH contaminated sediments in place and to prevent their escape into Sydney Harbour. The approach determined that, as PAHs have a low solubility in water, there would be little potential for the chemicals to leach from the sediments to the water in the Tar Ponds. The primary concern for PAH contamination of the receiving waters would arise from solid particles contaminated with PAH being physically disturbed and transported by coastal and hydrological processes such as tidal, current and wave action. An *in situ* containment would prevent particle erosion. Primary elements of the containment approach were to include:

- PCB contaminated sediments were to be removed from the Ponds for off-site treatment and/or disposal;
- PAH contaminated sediments were to be covered with 1.3 m of inert slag to bring the area above the high water mark;
- the slag cover was to be topped with 0.3 m of till and the newly created land was to be vegetated;
- new channels were to be constructed for the Coke Ovens Brook and Wash Brook; and
- a dam was to be constructed at Battery Point.

A risk analysis was subsequently conducted to compare the potential reduction in risks to human health of the PAH containment remediation approach with a "do nothing" option (JWEL-IT, 1996a). The risk assessment found that the containment approach was expected to reduce risks to human health by at least a factor of 80. The study did note that, following completion of the containment project, continuing discharge of PAHs from the Coke Ovens Brook would reduce the benefits. Although no effort was made to evaluate the risks to ecological receptors, the study noted that containment would effectively prevent direct exposure of the sediments to biota. The proposed containment project would require ongoing monitoring as the contaminant hazard would neither be removed nor destroyed.

This series of studies also investigated further the presence of PCB contamination within the North and South Ponds (JWEL-IT, 1996b) and assessed remedial methods for the PCB contaminated sediment. A total of 8 areas of PCB contaminated sediment were defined, varying considerably in size and thickness. The total *in situ* volume of PCB contaminated sediment was estimated at 36,000 m^3 (45,000 tonnes). Five remedial options were developed including landfilling, thermal desorption, incineration, containment, thermo-chemical treatment and bioremediation. A no action option was also examined. Thermal desorption was identified as the preferred route for treatment of the PCB contaminated sediment, with residual wastes from the process requiring incineration.

JWEL-IT Joint Venture also conducted a baseline data collection study (JWEL-IT, 1996c) in Sydney Harbour to document existing contaminant conditions in relationship to the findings of previous studies. Results of the field investigations indicated that the levels of PAHs in the sediments and in lobster in Sydney Harbour had declined since the earlier studies in 1981. However, levels of PAHs in mussels in the Harbour were significantly elevated relative to previous studies. The study also noted a trend of decreasing PAH concentration with increasing distance from Muggah Creek. The highest PCB concentrations recorded were in samples taken south of Muggah Creek.

There was some public opposition to the proposed containment approach to the cleanup of the Tar Ponds, and the project was never implemented.

1.5 PUBLIC CONSULTATION

An unprecedented level of consultation has occurred with the public and government stakeholders over a 7-year period. In 1996, citizens of the Sydney community and the 3 levels of government formed the Joint Action Group for the Environmental Cleanup of the Muggah Creek Watershed (JAG) to seek consensus around acceptable, safe, and technically sound cleanup solutions. Throughout the 7 years when JAG existed, residents of the CBRM had numerous opportunities for input into the recommendations made to government concerning remedial options for the Tar Ponds and Coke Ovens sites. Over that period more than 100,000 volunteer hours were spent and 900 public meetings were held to gather public opinions on what the future remedial options should involve.

1.5.1 Joint Action Group

JAG was comprised of local residents, business people, representatives of the 3 levels of government, and representatives from local communities, First Nations, and *bona fide* local organizations.

JAG was conceived to define and implement a workable solution to the environmental contamination contained within the area known as the Sydney Tar Ponds. JAG evolved and broadened its scope to include the former Coke Ovens site, as well as the downstream impacts of the existing Municipal Landfill (JAG, 1998).

A Memorandum of Understanding (MOU) was signed on 19 September 1998 by the Government of Canada, the Government of Nova Scotia, the Cape Breton Regional Municipality (CBRM), and the JAG setting out a framework for a community based process (known as the JAG process). This process expressed the collective will of all parties to seek solutions to the environmental and health risks associated with the Muggah Creek Watershed (JAG, 1998).

JAG was supported by a Secretariat, managed by a Steering Committee, and reported to a Roundtable made up of approximately 40 to 45 community representatives and 6 government representatives (2 from each level of government). JAG's mission was "to educate, involve and empower the community, through partnerships, to determine and implement acceptable solutions for Canada's worst hazardous waste site, and to assess and address the impact on human health" (JAG, 1998).

JAG identified the process outlined in the Canadian Council of Ministers of the Environment (CCME) National Guidelines for Decommissioning of Industrial Sites (CCME, 1991) as an appropriate process for application to the remediation project. The CCME Guidelines include a multi-phased approach that allows for the full assessment and characterization of the contaminated site in support of the development and implementation of site-specific remediation plans.

In February 2003, JAG was presented with a report containing a short list of safe and effective remedial options. The Remedial Action Evaluation Report (RAER) (CBCL/ENSR, 2003) identified options that were technically feasible and commercially available, and provided a short list of 4 preferred remedial options for each of the 2 sites. This evaluation process also included criteria such as duration of remediation and the associated costs for each option.

JAG subjected this report to an intense public consultation. More than 1,700 residents took part in workshops to consider the options in detail. Table 1.1 summarizes the remedial options that were assessed by JAG for both sites.

The results of the JAG consultation provided a cross-section of views on how best to remediate the Tar Ponds and Coke Ovens. JAG considered the community response and, in May 2003, JAG urged governments to use removal and destruction technologies in the remediation of the Tar Ponds and Coke Ovens.

1.6 RECENT DATA AND STUDIES

At the request of JAG, and following the CCME Guidelines, governments have undertaken a number of studies and projects intended to advance the CCME process for the remediation of the Tar Ponds and Coke Ovens sites, and to take direct action on a number of immediate issues facing the remediation process. These are identified in this section.

1.6.1 Site Investigations

In 1997, in support of a JAG resolution, Environment Canada initiated a study to determine the extent of contamination that was associated with selected materials and structures remaining on the Coke Ovens site (CBEG, 1997). The report provided a chemical assessment of the residual contamination associated with 21 areas of the site, including the remaining structures and/or waste materials. The information was intended to assist with the planned demolition, removal and disposal of these materials and structures. The main findings of the study were as follows:

- Levels of benzene, toluene, ethylbenzene, and xylene (BTEX)/total petroleum hydrocarbons (TPH), and PAH/phenols were found to exceed the CCME guidelines in many of site soil and water samples;
- Concentrations of certain metals in the soil (i.e., copper and zinc) and water (i.e., iron and mercury) samples exceeded CCME guidelines; and
- Samples of tar-like residue collected from the surface of the vessel at the By-Products Building, and in samples of water taken from the basement of former Coke Batteries 5 & 6, showed elevated concentrations of semi-volatile organic compounds (EPA 625), other than PAH/phenols.

TABLE 1.1 Summary of Proposed Remediation Options

Tar Ponds Remediation Options	Description
Excavation of North Tar Pond, Containment in South Tar Pond.	This option would excavate sediment from the North Tar Pond and place it in a bermed containment area to be built in the South Tar Pond. When completed, the containment facility would be fitted with an engineered cap and planted with grass. PCB material would go to an offsite incinerator approved for PCB destruction.
Excavation of both Tar Ponds, Containment at Coke Ovens.	This option would excavate sediments from both Tar Ponds, solidify them, and place them in an engineered containment facility at the Coke Ovens site. PCB material would go to an offsite incinerator approved for PCB destruction.
Excavation, Soil Washing, Bioremediation, Co-Burning, and Containment.	This option would excavate sediment from both Tar Ponds and treat it with soil washing and possibly bioremediation. Fuel material recovered in this manner would go to an offsite power plant or cement kiln for co-burning. PCB materials would be treated onsite with pyrolysis or thermal desorption, then destroyed through offsite incineration, plasma, or hydrogen reduction. In both cases the treated sediment would be sent to the Coke Ovens site and, if necessary, placed there in an engineered containment facility.
Excavation and Co-Burning	This option would excavate sediment from both Tar Ponds and send it to a power plant or cement kiln for co-burning. PCB material would go to an offsite incinerator approved for PCB destruction.
Excavation and Onsite Incineration	This option would excavate sediment from both Tar Ponds and incinerate it onsite in an approved facility or facilities. Incinerator ash would go to an engineered landfill at the Coke Ovens site.
Containment and Capping of Both Ponds	This option would contain sediment in both ponds under an engineered cap. Grass would cover the above-water portions of the cap (all of the South Pond and part of the North Pond).
Coke Ovens Remediation Options	**Description**
Excavation, Bioremediation and Containment	This option would bioremediate PAH-contaminated surface soils and then cover the excavated area with soil and plant with grass. Cutoff walls would prevent subsurface contaminated groundwater and coal tar from intruding into the lower reaches of Coke Ovens Brook. A trench in the old streambed would collect coal tar and groundwater, with the groundwater going to a water treatment plant.
Excavation and Containment	The option would excavate the top 2 m of soil from contaminated areas and replace it with imported fill. The contaminated soil would go into an engineered landfill on site. Underground chambers and tunnels would be removed or filled, and the site would be covered with soil and planted with grass.
Excavation, Soil Washing and Co-Burning	This option would excavate the top 2 m of soil from contaminated areas and replace it with imported fill. Soil washing would separate contaminants from excavated soil. Fuel material recovered in this manner would be sent to an offsite power plant or cement kiln for co-burning. The remaining material would go into an engineered landfill on site. Underground chambers and tunnels would be removed or filled, and the site would be planted with grass.
Excavation, Pyrolysis and Co-Burning	This option would excavate the top 2 m of soil from contaminated areas and replace it with imported fill. Pyrolysis would separate contaminants from the excavated soil. Fuel material recovered in this manner would be sent to an offsite power plant or cement kiln for co-burning. The remaining material would go into an engineered landfill on site. Underground chambers and tunnels would be removed or filled, and the site would be planted with grass.

Source: Imagine What our Community Could Be…. Short List of Options (JAG, 2003)

Additional sampling at 8 locations within the Coke Ovens site was subsequently undertaken to supplement the information attained by the 1997 materials sampling program (JWEL, 1998). These additional samples identified elevated concentrations of PAHs in the soil at the site of the former Coke Batteries, as well as elevated concentrations of a number of parameters at the Small Standpipe.

This JWEL report made a number of recommendations including the following for the remediation and/or disposal of waste materials from 3 specific areas of the Coke Ovens site:

- landfill disposal for the sludge waste from the Benzol Tank;
- incineration of the wood waste from the Cooling Tower Grids; and
- capping in place of the brick waste in the Brick Storage Area.

Two related studies were also carried out at this time that related to the Coke Ovens site; these included:

Assessment of Source of Contamination, Lower Frederick Street (CBEG, 1998): This study investigated the water quality of the groundwater seeps located along the former Cape Breton Development Corporation (CBDC) rail bed to the south of Frederick Street. These seeps were determined to be a result of groundwater flowing into and out of an old culvert, as well as the movement of the groundwater through the rail bed material itself. Potential sources of the metal contamination detected in the groundwater seeps were identified as including the Coke Ovens site, the rail bed material, the municipal landfill (located to the south and east and upgradient of Lower Frederick Street, but within the watershed), fill material, and air borne deposition; and

Sydney Coke Ovens and Tar Ponds: A Preliminary Botanical Inventory and Vegetation Analysis (Haber, 1998): This study involved site surveys on both the Tar Ponds and Coke Ovens sites to identify existing vegetation, rare species, toxic substances and the potential for phytoremediation of the area. A diverse array of plant species were identified on the sites, including some unusual mosses. Although the study noted elevated concentrations of certain heavy metals, none were identified as hyper-accumulating.

1.6.2 Muggah Creek Watershed Phase I Environmental Site Assessment

In 1998, Environment Canada, at the request of the Environmental Data Gathering and Research Working Group (EDGAR) of JAG, commissioned the Phase I Environmental Site Assessment, Muggah Creek Watershed as the first step in the environmental cleanup of industrial lands in this area. The Phase I ESA was completed by CBCL Limited and Conestoga-Rovers & Associates Limited in 1999. The Phase I ESA (CBCL/CRA, 1999) examined all environmental investigations and studies on the Muggah Creek Watershed over the previous 20 years, as well as all available information on historic and existing industrial and commercial facilities and activities. The study provided a summary of the history of previous activities on the Tar Ponds and Coke Ovens sites and improved existing knowledge of environmental conditions that may or do exist within the former industrial lands of the Muggah Creek Watershed.

The Phase I ESA, based entirely on existing and available information, determined that the nature and location of contamination at the Tar Ponds and Coke Ovens sites was known with a moderate to high degree of certainty. A lower degree of certainty was attached to the delineation of the extent of specific contaminants at the sites, since much of the earlier field investigations focused on the identification of contaminants rather than the delineation of contaminated areas.

1.6.3 Muggah Creek Watershed Phase II Environmental Site Assessments Coke Ovens Site

The Phase II ESA, which was completed in 2001 by JDAC Environment, focused on the collection and interpretation of data pertinent to the Coke Ovens site and several adjoining areas, particularly the Municipal Ash/Industrial Disposal (MAID) site, the Coke Ovens Brook Connector, and the Area North of the Coke Ovens (NOCO) (JDAC, 2001b) (see Figure 1.3). The program included groundwater monitoring and sampling, surface water monitoring and sampling, soil sampling, stratigraphic logging and groundwater modelling.

The Phase II ESA delineated the distribution of metal and organic contaminants in both soil and groundwater at the sites and characterized the contaminant transport pathways. This work was augmented by the program undertaken by JDAC Environment to sample surface soils in areas outside the study boundary of the Phase II/III Muggah Creek Project (JDAC 2002d). The key issues arising from the referenced study are summarized as follows:

- The fill materials on the Coke Ovens site are contaminated with metals and organic compounds. Fills contaminated with coal-related metals have been identified in some of the areas of the site that have been used for coal-handling, and there is evidence of contaminated fill associated with industrial wastes from previous coking, tar processing and light oil processing activities;
- Coke Ovens Brook intercepts much of the groundwater that underlies both the MAID site and the Coke Ovens site;
- Semi-solid coal tar occurs along several reaches of the Coke Oven and Domtar Brooks and has the potential to act as an ongoing source of coal tar contaminants to surface water in the area;
- The Domtar site is characterized by extensive soil and groundwater contamination including both metals and organic compounds;
- The understanding of the Canso-Morien contact was enhanced insofar as the actual contact surface may not have a consistent slope, but may become shallower as it plunges under the Coke Ovens site;
- The Benzol Plant and By-Products Building area is characterized by concentrated occurrences of organic contamination, which is likely related to the processing and handling of light oils in this location;
- The surface and subsurface soils of the Cole Pile Runway, as well as groundwater, are contaminated. Low pH and organics (BTEX and PAH) were noted in the groundwater;
- The MAID site leachate plume migrates westward onto the Coke Ovens site;
- Since only a single site-wide set of data was compiled, the groundwater flow under varying hydrologic conditions was not determined. Seasonal changes in groundwater quality and radiological parameters were not fully evaluated ;
- Field programs identified widespread contamination in the surface soils of the NOCO site, but there was less evidence of contamination in the sub-surface soils in this area;
- Groundwater contamination was identified in several areas and was thought to be related, in part, to migration from the MAID site and the Coal Pile Runway; and
- Substantial buried infrastructure still exists within the Coke Ovens site.

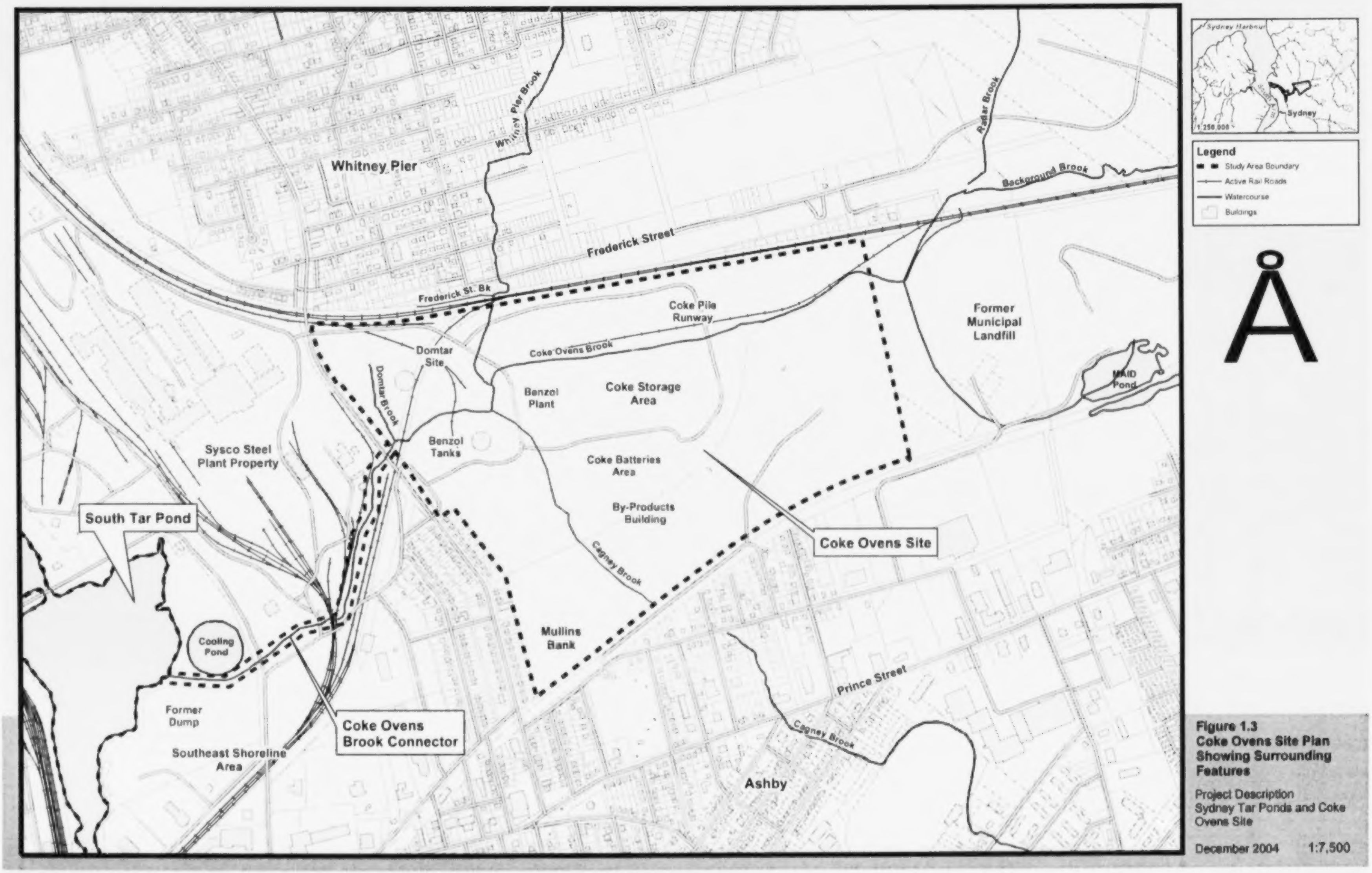
Sydney Harbour
Sydney
1:250,000
Legend
Study Area Boundary
Active Rail Roads
Watercourse
Buildings
Whitney Pier
Whitney Pier Brook
Radar Brook
Background Brook
Frederick Street
Frederick St. Bk
Coke Pile Runway
Former Municipal Landfill
MAID Pond
Domtar Site
Coke Ovens Brook
Domtar Brook
Benzol Plant
Coke Storage Area
Benzol Tanks
Coke Batteries Area
Sysco Steel Plant Property
By-Products Building
South Tar Pond
Coke Ovens Site
Cagney Brook
Cooling Pond
Mullins Bank
Prince Street
Former Dump
Coke Ovens Brook Connector
Southeast Shoreline Area
Ashby

Figure 1.3
Coke Ovens Site Plan Showing Surrounding Features

Project Description
Sydney Tar Ponds and Coke Ovens Site

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1.6.4 Muggah Creek Watershed Phase III Environmental Site and Risk Assessments Coke Ovens Site

The final Environment Site and Risk Assessments Report regarding the Coke Ovens site (JDAC, 2002c) included the results of field investigations carried out on the Coke Ovens site in 2001. These investigations were designed primarily to assist in the determination of human health and ecological risks.

The Coke Ovens site was divided into 5 distinct areas plus the Coke Ovens Brook Connector. Samples were collected from surface soil, subsurface soil, surface water and groundwater. COCs in each of these media were identified and the extent of contamination delineated in each area.

All areas, except the Mullins Bank/Non-Point Source Areas, were determined to have elevated concentrations of Chemicals of Potential Concern (COPC) Elevated concentrations of petroleum hydrocarbons and PAHs were generally found in the surface soils, while coal tar/oil products were noted to occur in the subsurface fills and on the surface. Elevated levels of inorganics (metals) were most often confined to relatively discreet areas of the site. It was estimated that the primary pathways for coal tar migration occur within the surface water channels. Coal tars exist throughout the stream bed of the Coke Ovens Brook where it traverses the site, and in the stream bed of the Coke Ovens Brook connector.

The Coke Ovens Site Risk Assessment examined the potential risk of exposure to COPCs for a number of well defined human and ecological receptors. The Risk Assessment examined exposure pathways, estimated toxicity, and evaluated each COC based on established benchmarks for definition of unacceptable risk. Where the potential for unacceptable levels of risk was identified, the Risk Assessment determined Site Specific Target Levels (SSTLs) focused on each COC, in each media, and based on defined exposure pathways for each receptor. These SSTLs establish those concentrations of COCs above which the risk to human and ecological health is not acceptable.

The Coke Ovens Risk Assessment was supplemented by a report that further delineated the Remedial Action Objectives (RAOs) and target SSTLs (CRA, 2002a).

1.6.5 Muggah Creek Watershed Phase III Environmental Site Assessment Ponds and Shoreline Areas

Sufficient data was provided in the Phase I ESA report, and previous investigations, to allow the remediation project to proceed immediately with a Phase III investigation of the Tar Ponds (JDAC, 2001a) (see Figure 1.4). The Phase III ESA study of these areas was intended to build upon the existing data to better delineate contaminant boundaries and quantities. The study area included the North and South Ponds and adjacent shoreline areas.

The Phase III ESA (JDAC, 2001a) documents the results of field investigations carried out in the Tar Ponds area in 2000. Two related studies were also completed in conjunction with the Phase III ESA; these were:

- Contaminant Flux from Muggah Creek to Sydney Harbour (JDAC, 2002b); and
- Contaminant Loading Study for Muggah Creek (JDAC, 2002a).

Much of the known information on the Tar Ponds was confirmed by the Phase III ESA (JDAC, 2001a), including the location and quantity of elevated levels of PCB and PAH contamination in sediments.

Contaminants identified in the Phase III ESA included PAHs, PCBs, semi-volatiles, metals (lead, copper, cadmium, chromium, zinc, mercury and arsenic), petroleum hydrocarbons and light end volatile compounds (BTEX), HNCs, and dioxins/furans.

The volume of PAH impacted sediment in the 2 Ponds was estimated at 550,000 m^3 and the estimated volume of PCB sediment (>50 ppm) was estimated at 45,000 m^3 (*in situ*). Of this, the North Pond contains an estimated 36,000 m^3 of PCB sediment, most of which is in a single deposit near Battery Point, and the South Pond contains an estimated 9,000 m^3. The contaminated sediment in the North Pond lies in a discreet layer of varying thicknesses that is located between layers of PAH contaminated sediments and slopes downward. The PCB material in the South Pond is primarily located close to the surface of the sediment in a relatively accessible location.

PAH contaminated sediment was also found in deeper layers of sediments located beyond the existing shoreline and outside the boundaries of Tar Ponds site. These areas are a result of historic infilling, including that connected with the former steel plant site and its associated slag pile located to the east and north of the North Pond, and the old waste dump located to the southeast of the South Pond.

The Contaminant Loading Study for Muggah Creek (JDAC, 2002a) also examined the inputs received from groundwater sources and sewer outfalls. The findings of the Study as related to the source and estimated loadings of contaminants from all sources are provided in Table 1.2.

TABLE 1.2 Contaminant Loadings into Muggah Creek

Contaminant Type	Total Estimated Loading (kg/year)	% Contribution Surface Water	% Contribution Groundwater	% Contribution Sewer Outfalls
Hydrocarbons	25,709	68	5	27
Metals	1,942	56	28	16
PAHs	310	23	75	2

Note: Reference: Table 3.1 in Contaminant Loading Study for Muggah Creek (JDAC, 2002a)

The Contaminant Flux from Muggah Creek to Sydney Harbour Study (JDAC, 2002b) modeled the inputs and outputs of Muggah Creek to simulate the pattern of the contaminant flows. The results suggested that the South Pond functions as a sediment trap retaining about 220 tonnes of sediments per year and accumulating 18 tonnes of contaminants per year. The North Pond is estimated to have a net release of contaminants to Sydney Harbour of over 7 tonnes per year. Inputs and outputs for each contaminant type are provided in Table 1.3. Although the table provides the net gain/loss for each contaminant type, there are variations within each type.

TABLE 1.3 Contaminant Inputs and Outputs for Muggah Creek

Contaminant Type	Input to South Pond (kg/year)	Output from South Pond (kg/year)	South Pond Gain/Loss (kg/year)	Input to North Pond (2) (kg/year)	Output from North Pond (kg/year)	North Pond Gain/Loss (kg/year)
Hydrocarbons	24,455	7294	17,161	9041	15451	-6,410
Metals	1,431	635	796	1075	1250	-175
PAHs	244	163	81	226	777	-551
TOTAL	26,130	8092	18038	10,342	17,478	-7,136

Note: Reference: Table 6.1 in Contaminant Flux from Muggah Creek to Sydney Harbour (JDAC,2002a)
Includes output from South Pond plus groundwater and sewer outfalls into North Pond

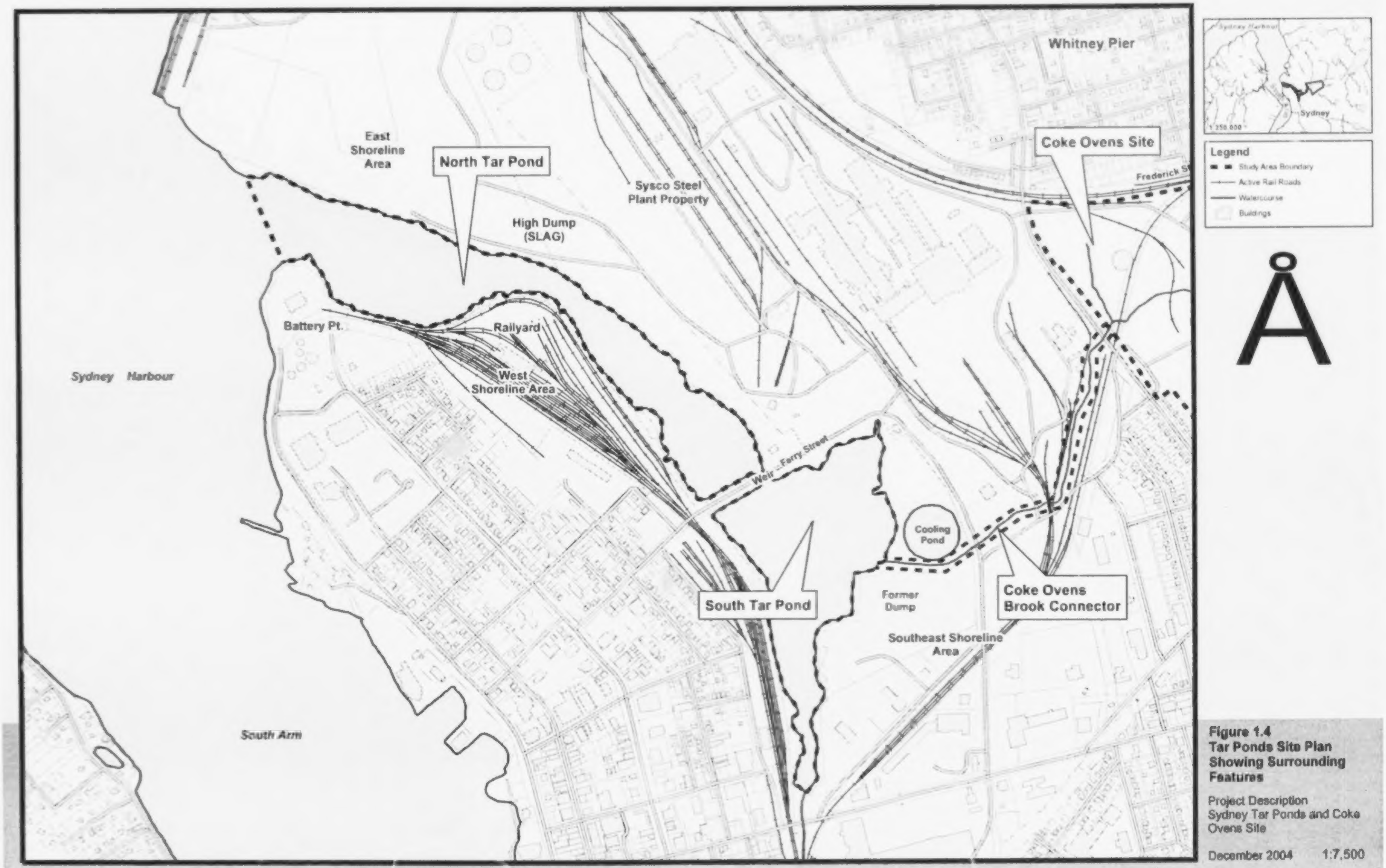
Whitney Pier
Coke Ovens Site
Frederick St
Sysco Steel Plant Property
High Dump (SLAG)
East Shoreline Area
North Tar Pond
Battery Pt.
Railyard
West Shoreline Area
Sydney Harbour
South Arm
Weir - Ferry Street
South Tar Pond
Cooling Pond
Former Dump
Southeast Shoreline Area
Coke Ovens Brook Connector
Sydney Harbour
Sydney
1:250,000
Legend
Study Area Boundary
Active Rail Roads
Watercourse
Buildings

Figure 1.4
Tar Ponds Site Plan Showing Surrounding Features

Project Description
Sydney Tar Ponds and Coke Ovens Site

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1.6.6 Human Health and Ecological Risk Assessment North and South Ponds

The Human Health and Ecological Risk Assessment for the North and South Ponds (JDAC, 2002c) was based on data obtained from the Phase III ESA (JDAC, 2001a) and additional field investigations. The purpose of the risk assessment was to evaluate the potential risks associated with the chemicals currently present in the Tar Ponds. Contaminants of Concern were identified by comparing the detected chemical concentrations to conservative screening values and background levels. If a COC was determined to pose an unacceptable risk or hazard, a site-specific target level (SSTL) was developed.

The Risk Assessment evaluated the potential for adverse effects to human receptors that might come into contact with contaminants in the surface water and sediments of the North and South Ponds. Based on possible receptors and exposure pathways, 4 potential classes of receptors were identified including:

- a commercial worker (Ferry Street kiosk);
- a maintenance worker;
- a trespassing child and teen; and
- a residential child/adult living in a home located adjacent to the Ponds.

The results of the Risk Assessment indicate the following:

- For the on-site commercial worker, a few PAHs might pose a potential for adverse non-carcinogenic effect. Potential exposures from PAHs might also pose unacceptable potential cancer risks;
- For the on-site maintenance worker, exposure might pose an unacceptable non-cancer hazard;
- For the trespasser who was a life-time resident, carcinogenic PAHs pose a potentially unacceptable health hazard; and
- For the frequently trespassing child, who was considered as a predominantly off-site residential receptor for a lifetime, the potential exists for a few PAHs to pose an adverse non-carcinogenic effect.

It should be noted that groundwater flows into the North and South Ponds from all directions so there is little likelihood that contamination from the Ponds could reach off-site receptors *via* groundwater. The potential for evaporation of chemicals from the Ponds and their migration to any off-site resident receptors at a detectable concentration is also considered negligible. Therefore, the risk of exposure to nearby residents from chemicals in groundwater or air associated with the Ponds is considered to be insignificant.

The Risk Assessment evaluated the potential for adverse effects to non-domesticated flora and fauna receptors in the ecological habitats of the Tar Ponds study area. No species or habitats at risk, as listed in COSEWIC (Committee on the Status of Endangered Wildlife in Canada) and the Nova Scotia Endangered Species List, were identified in the study area. Environmental media of interest included the shoreline soils and pond sediment and surface water. The Risk Assessment of ecological receptors included populations of fish, invertebrates, birds or mammals that may exhibit increased mortality or decreased reproduction, due to chemical presence. For each medium and receptor, a variety of COPCs were identified that posed potential ecological hazards. For aquatic receptors, PCB arochlors, PAHs, and metals were, generally, above the risk benchmark. SSTLs were calculated for each COPC, based on the ecological receptor and the contaminated media.

1.6.7 Technology Demonstration Program

In response to a JAG resolution, in 2000, the Nova Scotia Department of Transportation and Public Works contracted Vaughan Engineering Limited to coordinate a Technology Demonstration Program (TDP) (Vaughan, 2002) to evaluate the potential for application of a selection of treatment technologies to the remediation of the Tar Ponds sediment. Technologies were selected for bench-scale testing on Tar Ponds media based on submitted proposals.

Proponents of technologies who participated in the TDP included:

- Colmac Resources Inc. (Colmac): circulating fluidized bed (CFB) co-burning technology;
- Grace Canada Inc. (Grace): solid phase bioremediation technology;
- IT Corporation (IT): solidification/stabilization technology;
- IT Corporation (IT): thermal desorption technology;
- Science Application International Corporation Canada (SAIC Canada): solvent extraction, acid leaching and plasma destruction;
- TDEnviro: advanced soil washing technology; and
- UMATAC Industrial Processes (UMATAC): pyrolysis technology.

Each proponent technology received at least one 200 L drum of high concentration PCB sediment and one 200 L drum of low concentration PCB sediment.

In the context of the TDP, the focus was to determine the feasibility and suitability of various proven remediation technologies on actual samples of sediments in terms of their capability and performance. This was done by providing for testing samples of the 2 principal types of sediment, namely those low in PCB (<50 ppm) and those high in PCB (>50 ppm). The reference to low PCB sediments is this section reflects the categorization used in the TDP.

The intent of the bench scale demonstration projects was to produce a treated sediment that met specific criteria established for the TDP, such that the treated material could be safely disposed of at any licensed landfill site. Three technologies were successful in reducing the level of PAH and PCB contamination to below the criteria established for the TDP. These included Colmac's CFB co-burning technology (for low PCB material), SAIC Canada's plasma destruction (for both the low and high PCB material) and UMATAC's pyrolysis technologies (for both the low and high PCB material).

All 7 bench scale technologies tested produced treated sediments that contained levels of at least one heavy metal contaminant above the cleanup guidelines. Results of the TDP also demonstrated that water treatment would be required to remove contaminants for all technologies that had an associated water discharge. In some circumstances, the treatment of air emissions would also be required. The TDP summarized each demonstration as indicated in Table 1.4 and described below:

TABLE 1.4 Technology Demonstration Program (TDP) Results - Benefits and Limitations

Proponent	TDP Test Results	Technology Track Record	Benefits	Limitations
Colmac CFB Co-Burning	Good PAH destruction	Previous tests successful on similar material	Beneficial reuse of sediment; low capital costs (existing power plants could be used)	Power plants must have ash handling capacity; and agree to accept waste materials with low levels of PCB (<50 mg/kg) PCB materials (>50 mg/kg) were not tested
Grace Bioremediation	Poor sediment treatment Good water treatment	Little full-scale experience with similar material	Lower cost solution Low power requirements	Prolonged time frame for remedial action Large space requirements Susceptible to climate conditions (no winter operation) Residual materials may require contained disposal
IT Stabilization/ Solidification	No improvement in contaminant levels after treatment Sediments pass leach criteria before and after treatment	Successful application on materials with high inorganic contaminants Less experience on application to organic contaminants	Improved handling capabilities Higher chance leach criteria will be consistently met after stabilization	Up to a 40% increase in volume of treated materials Residual materials could still require contained disposal Long-term immobility of some compounds not proven No destruction of contaminants
IT Thermal Desorption	Successful destruction of PAH	Previous tests successful on similar contaminated materials	High throughput possible Proven technology	Highly variable feed could limit effectiveness Metals could concentrate in treated material Residence time must increase if material "balls" up
SAIC Canada Treatment Chain	Unsuccessful results with solvent extraction and acid leaching Successful results with plasma	Some success noted with solvent extractions Plasma is typically used to treat relatively small quantities of material	Potential to reduce contaminated material to smaller volume Plasma treatment mineralizes (completely destroys) organics	Solvent extraction and metal leaching might not be effective for some compounds (e.g., benzo(a)pyrene) Trace solvent could remain in treated sediment Estimated high costs
TDEnviro Soil Washing	Carbon fuel successfully produced Inorganic contaminants require additional treatment	Documented commercial-scale CSP success for oil impacted material	Yields fuel product with high calorific value	Fuel user would require ash handling capabilities Fuel user must agree to accept material PCB material (>50 mg/kg) not addressed
UMATAC Pyrolysis	Good PAH destruction	Commercial-scale success for PCB and oil impacted material	Recovered product could be produced and sold	Minor volume increase could occur due to addition of sand Recovered product could contain PCB's and require treatment

- Colmac CFB co-burning: Good results indicated that this technology was suitable and would be potentially feasible for the treatment of low PCB sediments;
- Grace bioremediation: This process showed no improvement in PAH levels. PCB levels were reduced, but the results were inconclusive as the control also had reduced PCBs;
- IT stabilization/solidification: Improved the handling of the sediment, but had little, if any, effect on the leachability, noting that the untreated sediments had already passed the leach tests on 2 samples;
- IT thermal desorption: Good results indicated a high reduction of PAHs in the feed sediment. However, IT believes that thermal desorption would be an overly expensive solution for this type of material, proposing instead a partially pyrolytic rotary kiln with secondary combustion;
- SAIC Canada treatment chain: The solvent extraction and metal leaching processes did not have acceptable contaminant reduction results. However, plasma destruction successfully destroyed the organic contaminants;
- TDEnviro advanced soil washing: Good results, but only the low PCB sediments were tested. They produced a carbon fuel suitable for commercial use, e.g., in cement kilns or power plants. The waste sediment, however, required secondary treatment, such as thermal desorption, to meet soil criteria established for the TDP; and
- UMATAC pyrolysis: Good results indicated a very high reduction of PAHs in the combusted solids. The condensate oils could be reused as commercial fuel, but the PCBs concentrated therein might need to be removed or treated.

Other points noted by Vaughan included:

- The tests undertaken served their purpose as screening tests by identifying key parameters which have the greatest influence on meeting the remediation criteria established for the TDP and on future design. For example, the low residence time and oxygen levels of Colmac's co-burning pilot-scale CFB produced CO levels that are not expected at full-scale;
- The low and high PCB sediment samples, while similar in PAH concentration, were very different in petroleum hydrocarbon content which had a major impact on not only the treatability of the sediment using some technologies (e.g., solvent extraction), but also on material handling; and
- Treatment criteria will vary with land use, and the criteria established for the TDP and applied during this evaluation may not be appropriate in all cases (e.g., soils criteria do not apply to fuels produced from the sediment).

1.6.8 Community Evaluation Criteria and Future Site Use

In 2002, JAG undertook a program of public consultation that resulted in the identification of 16 evaluation criteria intended to ensure the inclusion JAG Core Principles in the evaluation of approaches and technologies for the remediation of contamination at the Tar Ponds and Coke Ovens sites (JAG, 2002). These Core Principles and Evaluation Criteria included:

- **Environmentally Sound** – actions that support and promote the protection, enhancement, and prudent use of the environment, which are based on sound science

and engineering principles, and that the precautionary principle will be used in decision-making so that where there are threats of serious or irreversible damage, the lack of full scientific certainty shall not be used as a basis for postponing measures to prevent and eliminate environmental degradation. Evaluation criteria included:
  - Reduce detrimental effect on environment during implementation
  - Enhance long-term effectiveness and permanence
  - Improve marine and land ecosystems
  - Minimize energy use
  - Reuse of contaminants

- **Economically Responsible** – ensuring that resources are used efficiently and productively so that the level of local economic benefits, including direct and indirect benefits, is acceptable to all parties for the results achieved as compared with the costs incurred. Evaluation criteria included:
  - A more reliable technology (i.e., proven technology)
  - Cost effectiveness
  - Use of local material
- **Health Conscious** - that all actions of JAG are based on sound science and recognized standards and that no such actions will be undertaken whereby the community is exposed to unacceptable health risks. Evaluation criteria included:
  - Minimize the amount of dust and vapours
  - Minimize odours
  - Minimize the amount of noise
  - Minimize the amount of traffic
  - Minimize health risk
- **Socially Acceptable** – JAG shall ensure that all its major decisions are broadly understood and preferred by the citizenry of the CBRM. Evaluation criteria included:
  - Maximize long-term benefits
  - Minimize length of construction and cleanup time
  - Use of local labour
- **Community Driven** - the direction, decisions, and actions made by JAG are based on consultation, input, and agreement of the wider community.
- **Publicly Accountable** - the JAG process is founded on the organization answering to the public, especially those in the community surrounding the Watershed; in order to do this, JAG commits to the following: 1. Hold open meetings to the public in general. 2. Ensure accessible records in general. 3. Ensure environmental and health-risk assessments for all remedial or cleanup tasks (as prescribed by the *Canadian Environmental Assessment Act* (CEAA) and the *Nova Scotia Environment Act*) are acceptable to JAG and consistent with the legislative authority of the government parties. 4. Develop ongoing efforts to maximize JAG having a community-driven process.

Participants to the process ranked the relative importance of each of the criteria and provided overall comments. Within each of the Core Principles, the following evaluation criteria received the highest public ranking:

- Environmentally Sound – Enhance long term effectiveness and permanence (i.e., long-term effectiveness and permanence refers to expected remaining risk and the ability of a remedy to provide protection of human health and the environment, over time following a cleanup);

- Economically Responsible – Use a more reliable technology (i.e., assuming 2 technologies achieve the same level of cleanup but one method has a longer and more proven track record, the more reliable technology will reduce the risk of process upsets and unexpected costs);
- Health Conscious – Minimize health risk (i.e., the ability of a technology to create reliable protection of human health once cleanup levels have been met. This includes the consideration of cleanup residuals and the potential risk for exposure to humans); and
- Socially Acceptable – Maximize long-term benefits (i.e., long-term benefits can be defined as those results that prove to enhance the community by providing some additional resources that would not otherwise be present).

Responses from participants in the consultation process indicated a preference for the future use of the Tar Ponds site as public parkland with a mixture of uses including waterway, recreational areas with green space, playgrounds, family areas and boardwalks.

1.6.9 Environmental Effects and Remediation of Contaminated Sediments in Sydney Harbour

This research initiative led by staff of Fisheries and Oceans Canada includes work that is intended to accomplish the following objectives:

- determine the concentration of contaminants in sediments, water and biota of Sydney Harbour;
- determine the historical record of contamination inputs to Sydney Harbour;
- develop ecologically relevant biotests for assessing the cumulative effects of toxic substances and their risk to the ecosystem and to human health;
- establish linkages among multiple environmental indicators; and
- use historical records to better understand past and present environmental conditions.

Work on this study is ongoing, and the resultant reports have not yet been published.

1.6.10 Remedial Action Evaluation Report (RAER)

The primary objectives of the RAER project (CBCL/ENSR, 2003a and 2003b) were to:

- identify comprehensive remedial alternatives that will involve one or more commercially proven remedial technologies or management options for the remediation of the Tar Ponds site;
- evaluate at least 4 preferred remedial options for each site; and
- document the remedial action evaluations considered.

The RAER Team recommended 6 Cleanup Options for the Tar Ponds site that encompassed a range of possible and practical solutions:

- Option 1: removal of North Pond sediment and containment in a Confined Disposal Facility (CDF) in the South Pond with removal and off-site destruction of PCB material;
- Option 2: complete removal and land-based containment on the Coke Ovens site with removal and off-site destruction of PCB material;
- Option 3: complete removal, multi-technology treatment/destruction and land-based containment at the Coke Ovens site with on-site treatment of PCB materials and off-site destruction of concentrated contaminants;
- Option 4: complete removal, off-site co-burning destruction of PAH sediment with off-site incineration of PCB material;
- Option 5: complete removal, on-site incineration and land-based containment at the Coke Ovens site; and
- Option 6: *in situ* containment of the North and South Ponds.

Cleanup Option 1 for the Tar Ponds site (removal of North Pond sediment and containment in CDF in the South Pond with removal and off-site destruction of PCB) was based on the containment of most of the contaminated sediments from the Ponds in a newly constructed Confined Disposal Facility (CDF) in the South Pond. PCB materials (>50 mg/kg) would be separated and incinerated off-site. Option 1 could be executed in 4 years at an amortized cost of $152.3 million. Key components in the implementation of Cleanup Option 1 included the following:

- A cofferdam constructed across the North Pond at Battery Point;
- Surface water flows from the Brooks and outfalls redirected to isolated constructed channels that empty to the North Pond and Harbour;
- PCB materials (>50 mg/kg) excavated from the South Pond and incinerated off-site;
- PAH sediments in the South Pond contained *in situ* in a newly constructed Confined Disposal Facility;
- Sediments dredged from the North Pond, tested for PCBs and separated into PCB materials and PAH sediments;
- PCB materials (>50 mg/kg) from the North Pond incinerated off-site;
- PAH sediments from the North Pond dredged into the CDF in the South Pond and allowed to passively dewater;
- Sediments in the CDF treated with S/S as needed to enhance the effectiveness of the remediation;
- An above grade cover placed over the CDF in the former South Pond;
- A subaqueous cap placed over the dredged surfaces of the North Pond;
- North Pond shorelines and the re-routed watercourses stabilized and revegetated; and
- The surface and sides of the CDF stabilized and revegetated pending appropriate future use.

Cleanup Option 2 for the Tar Ponds (complete removal and land-based containment on the Coke Ovens site with removal and off-site destruction of PCB) involved the complete removal of contaminated sediments from the Tar Ponds and an *ex situ* containment (landfilling) of excavated sediments on the Coke Ovens site. PCB materials (>50 mg/kg) would be separated and transported offsite for incineration. Option 2 could be executed in 5 years at an amortized cost of $246.0 million. Key components in the implementation of Cleanup Option 2 included the following:

- A cofferdam constructed across the North Pond at Battery Point;
- Surface water flows from the Brooks and outfalls redirected to isolated constructed channels that empty to the North Pond and Harbour;
- PCB materials (>50 mg/kg) excavated from the South Pond and incinerated off-site;
- PAH sediments in the South Pond excavated, processed and deposited in a new land-based containment facility (landfill) constructed on the Coke Ovens site;
- Sediments in the North Pond excavated, tested for PCBs and separated into PCB materials (>50 mg/kg) and PAH sediments;
- PCB materials (>50 mg/kg) from the North Pond incinerated off-site;
- PAH sediments from the North Pond processed and deposited in a new containment facility (landfill) constructed on the Coke Ovens site;
- PAH sediments would be treated with S/S technology to improve material handling characteristics and reduce leachate potential prior to placement in the new containment facility;
- A subaqueous cap placed over the dredged surfaces of the South and North Ponds; and
- North Pond and South Pond shorelines and the re-routed watercourses stabilized and revegetated.

Cleanup Option 3 for the Tar Ponds (complete removal, multi-technology treatment/ destruction and land-based containment at the Coke Ovens site with on-site treatment of PCB materials and off-site destruction of concentrated contaminants) involved *ex situ* treatment and the destruction and containment (as required) of contaminated sediments excavated from the North and South Ponds. PCB materials (>50 mg/kg) would be separated, treated to concentrate contaminant levels, and destroyed off-site. Option 3 could require extensive material dewatering and processing to prepare the sediments for the treatment and destruction technologies. The timeline associated with implementation could be longer and the costs higher than to either Cleanup Option 1 or 2. Residual contaminated materials would be disposed of in a new land-based containment facility constructed on the Coke Ovens site. Option 3 could be executed in 7 years at an amortized cost of $323.8 million. Key components in the implementation of Cleanup Option 3 included the following:

- A cofferdam constructed across the North Pond at Battery Point;
- Surface water flows from the Brooks and outfalls redirected to isolated constructed channels that empty to the North Pond and Harbour;
- PCB materials (>50 mg/kg) excavated from the South Pond and treated through thermal desorption or pyrolysis to concentrate contaminants in the residual materials, which would be destroyed off-site using incineration, plasma or hydrogen reduction;
- PAH sediments in the South Pond excavated, processed and treated using soil washing or slurry phase bioremediation to reduce contaminant levels. If necessary, the treated

materials would be placed in a new containment facility constructed on the Coke Ovens site. Washings from the treatment processes would be co-burned as appropriate;

- Sediments in the North Pond excavated, tested for PCBs, and separated into PCB materials (>50 mg/kg) and PAH sediments;
- PCB materials (>50 mg/kg) from the North Pond treated through thermal desorption or pyrolysis to concentrate contaminants in the residual materials, which would be destroyed off-site using incineration, plasma, or hydrogen reduction;
- PAH sediments from the North Pond processed and treated using soil washing or slurry phase bioremediation to reduce the contaminant levels. If necessary, treated materials would be placed in a new containment facility constructed on the Coke Ovens site. Washings from the treatment processes would be co-burned as appropriate;
- A subaqueous cap placed over the dredged surfaces of the South and North Ponds; and
- South and North Pond shorelines and the re-routed watercourses stabilized and revegetated.

Cleanup Option 4 for the Tar Ponds (complete removal, off-site co-burning destruction of PAH sediment with off-site incineration of PCB material) involved the removal and off-site destruction of the contaminated sediments excavated from the North and South Ponds. Material handling and preparation requirements would be significant and would include debris removal, size control, dewatering, drying and the treatment of decanted water prior to release. Option 4 could be executed in 11 years at an amortized cost of $220.4 million. Key components in the implementation of Cleanup Option 4 included the following:

- A cofferdam constructed across the North Pond at Battery Point;
- Surface water flows from the Brooks and outfalls redirected to isolated constructed channels that empty to the North Pond and Harbour;
- PCB materials (>50 mg/kg) excavated from the South Pond, processed and incinerated off-site;
- Sediments in the North Pond excavated, tested for PCBs and separated into PCB materials (>50 mg/kg) and PAH sediments;
- PCB materials (>50 mg/kg) from the North Pond processed and incinerated off-site;
- All PAH sediments in the South Pond excavated, processed and coburned. Washings from the treatment processes would be co-burned as appropriate;
- A subaqueous cap placed over the remaining sediments in the dredged areas of the South and North Ponds; and
- South and North Pond shorelines and the re-routed watercourses stabilized and revegetated.

Cleanup Option 5 for the Tar Ponds (complete removal, on-site incineration and land-based containment at the Coke Ovens site) involved the removal of the contaminated sediments with the destruction and containment of residuals to take place on the Coke Ovens site. Material handling and preparation requirements would be significant and would include debris removal, size control, dewatering, drying and the treatment of decanted water prior to release. PCB materials would be incinerated on the Coke Ovens site. Option 5 could be executed in 11 years at an amortized cost of $238.9 million. The key components in the implementation of Cleanup Option 5 included the following:

- A cofferdam constructed across the North Pond at Battery Point;
- Surface water flows from the Brooks and outfalls redirected to isolated constructed channels that empty to the North Pond and Harbour;
- PCB materials (>50 mg/kg) excavated from the South Pond, processed and incinerated on-site at the Coke Ovens;
- Sediments in the North Pond excavated, tested for PCBs and separated into PCB materials (>50 mg/kg) and PAH sediments;
- PCB materials (>50 mg/kg) from the North Pond processed and incinerated on-site at the Coke Ovens;
- All (North and South Pond) PAH sediments processed and incinerated on-site;
- Residual materials from the incineration process disposed of in a new contained landfill facility on the Coke Ovens site, as needed;
- A subaqueous cap placed over the dredged surfaces of the South and North Ponds; and
- South and North Pond shorelines and the re-routed watercourses stabilized and revegetated.

Cleanup Option 6 for the Tar Ponds (*in situ* containment of the North and South Ponds) was be based on *in situ* containment of the contaminated sediments in the Tar Ponds. Option 6 could be executed in 4 years at an amortized cost of $100.4 million. Key components in the implementation of Cleanup Option 6 could include the following:

- A cofferdam constructed across the North Pond at Battery Point;
- Surface water flows from the Brooks and outfalls redirected to isolated constructed channels that empty to the North Pond and Harbour;
- A capping system constructed over the sediments in South and North Pond. Most of this cap would be above grade; and
- The shorelines and the re-routed watercourses stabilized and revegetated.

The RAER Team recommended 4 Cleanup Options for the Coke Ovens site that encompass a range of possible and practical solutions:

- Option 1: *in situ* containment and *in situ* treatment (bioremediation);
- Option 2: complete removal and *ex situ* containment on the Coke Ovens site;
- Option 3: removal and *ex situ* treatment (soil washing) and destruction (co-burning); and
- Option 4: removal and *ex situ* treatment (thermal desorption/pyrolysis) and destruction (co-burning).

Cleanup Option 1 for the Coke Ovens site (*in situ* containment and *in situ* treatment - bioremediation) was based on the *in situ* containment of most of the contaminated materials and the isolation of surface water from the remaining subsurface contaminants. *In situ* treatment would be used to reduce the concentrations of contaminants in the surficial soils prior to placement of the containment cover or cap. Option 1 could be executed in 4 years at an amortized cost of $68.5 million. Key components in the implementation of Cleanup Option 1 would include the following:

- Re-route surface water from the Coke Ovens Brook and other site watercourses to a newly constructed channel;
- Remove the contaminated sediments from the Coke Ovens Brook and the Coke Ovens Brook Connector;
- Install downgradient vertical barriers along the west side of the Coke Ovens site and the Coke Ovens Brook Connector to protect against potential NAPL migration;
- Cut-off upgradient groundwater flow into the site using walls and diversionary trenches;
- Pump and treat groundwater to prevent dissolved phase PAHs from contaminating Coke Ovens Brook and the Coke Ovens Brook Connector;
- *In situ* landfarm the top 0.5 m of surface soil to bioremediate PAHs and benzene;
- Cover the remaining area of the site with silty/clayey soils to reduce surface water infiltration;
- Potentially cover part of the Coke Ovens site with a containment facility (landfill) to contain the Tar Pond's sediments;
- Use institutional controls as required to ensure the safety of future construction workers, to address future indoor air issues for on-site buildings, and to meet, or exceed, occupational health and safety regulatory requirements with respect to vapours and odours; and
- Stabilize and restore the site.

Cleanup Option 2 for the Coke Ovens site (removal and land-based containment on the Coke Ovens site) involved the excavation of the contaminated fills and sediments with COC concentrations exceeding the SSTLs and their disposal in an *ex situ* containment facility (landfill) on the Coke Ovens site. Option 2 could be executed in 5 years at an amortized cost of $43.7 million. Key components of the implementation of Cleanup Option 2 would include the following:

- Re-route surface water from Coke Ovens Brook and other site watercourses to a newly constructed channel;
- Remove contaminated sediments from the Coke Ovens Brook and the Coke Ovens Brook Connector;
- Remove contaminated fills;
- Install downgradient vertical barriers along the west side of the Coke Ovens site and the Coke Ovens Brook Connector to protect against potential NAPL migration;
- Dispose of contaminated fills and sediments from the Coke Ovens site (and potentially) sediments from the Tar Ponds site in a new containment facility (landfill) built on the Coke Ovens site;
- Use limited institutional controls to address on-site indoor air issues as needed; and
- Stabilize and restore the site.

Cleanup Option 3 for the Coke Ovens site (removal, *ex situ* treatment (soil washing) and destruction (co-burning), *land-based containment at the Coke Ovens site) involved the* excavation of the contaminated fills and sediments with COC concentrations exceeding the SSTLs from the site, removal of the contaminants through a soil washing treatment, and the subsequent destruction of the concentrated contaminants. Option 3 could be executed in 7 years at an amortized cost of $123.3 million. Key components of the implementation of Cleanup Option 3 could include the following:

- Re-route surface water from Coke Ovens Brook and other site watercourses to a newly constructed channel;
- Remove contaminated sediments from the Coke Ovens Brook and the Coke Ovens Brook Connector;
- Remove contaminated fills;
- Install downgradient vertical barriers along the west side of the Coke Ovens site and the Coke Ovens Brook Connector to protect against potential NAPL migration;
- Treat excavated soil and sediment using soil washing with co-burning of washings;
- If needed, contain treated material from the Coke Oven site in an onsite landfill;
- Use limited institutional controls to address on-site indoor air issues as needed; and
- Stabilize and restore the site.

Cleanup Option 4 for the Coke Ovens site (removal and *ex situ* treatment (thermal desorption/pyrolysis) and destruction (co-burning)) was based on the excavation of the contaminated fills and sediment with COC concentrations exceeding the SSTLs, the removal or reduction of contaminants through thermal desorption or pyrolysis technologies, and the destruction of concentrated contaminants by co-burning. Option 4 could be executed in 7 years at an amortized cost of $109.2 million. Key components of the implementation of Cleanup Option 4 could include the following:

- Re-route surface water from Coke Ovens Brook and other site watercourses to a newly constructed channel;
- Remove contaminated sediments from the Coke Ovens Brook and the Coke Ovens Brook Connector;
- Remove contaminated fills;
- Install downgradient vertical barriers along the west side of the Coke Ovens site and the Coke Ovens Brook Connector to protect against potential NAPL migration;
- Treat excavated soil and sediment using thermal desorption/pyrolysis with co-burning of the concentrated contaminants;
- If needed, contain treated material from the Coke Oven site in an onsite landfill;
- Use limited institutional controls to address on-site indoor air issues as needed; and
- Stabilize and restore the site.

1.7 PROPOSED REMEDIATION OF THE TAR PONDS AND COKE OVENS SITES

The proposed remediation of the Tar Ponds and Coke Ovens sites is summarized in Table 1.5.

TABLE 1.5 Proposed Remediation Program

Activity	Tar Ponds Site	Coke Ovens Site
1. Control Water	Construct watercourse diversion channels to redirect surface water flowing through the Tar Ponds. This will isolate brooks and streams from contaminated Tar Pond sediments.	Reroute groundwater and surface water flowing through the site to minimize water contact with contaminants.
2. Remove and Destroy Selected Contaminants	Excavate, dredge, and dewater 120,000 tonnes (92,000 m^3) (*ex situ* volume) of sediment containing PCB material and destroy the dewatered sediment in an approved temporary PCB incinerator that will be constructed offsite in Industrial Cape Breton.	Excavate 1,300 tonnes (1,000 m^3) of PAH contaminated sediment from Coke Ovens Brook and 25,000 tonnes (12,500 m^3) of PAH contaminated material from the in-ground Tar Cell and destroy the excavated material in an approved temporary incinerator that will be constructed offsite in Industrial Cape Breton.
3. Treat Selected Contaminants In-place	Solidify and stabilize, in-place, the top 1 to 2 m of remaining sediment with a binder (such as Portland cement) using on-site auger or grout injection systems.	Treat, in-place, 253,700 tonnes (128,800 m^3) of the remaining contaminated surface soils using bioremediation. Landfarming of the top 0.5 m of contaminated soil will be used to promote biological breakdown of contaminants in surface soils.
4. Contain Residual Contaminants	Install a containment system designed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability barrier walls installed at various locations around the perimeter of the Tar Ponds and an engineered cap.	Install a containment system designed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability vertical walls installed at various locations around the perimeter of the Coke Ovens site and a soil cover designed to facilitate future site use(s).
5. Site Surface Restoration and Landscaping	Site restoration and landscaping will be compatible with the natural surroundings and future use.	Site restoration and landscaping will be compatible with the natural surroundings and future use.
6. Long-term Monitoring and Maintenance Plan	Monitor air quality, water quality, sediment, biota, and the performance of the containment system after completion of the project.	Monitor air quality, water quality, soil, and the performance of the containment system after completion of the project.

The remediation of the Tar Ponds and Coke Ovens sites will use technologies that have been demonstrated to be safe and effective on similar contaminated sites.

The worst (high levels of PCBs and PAHs) contaminants will be removed and safely destroyed using high temperature incineration. The licensed and approved temporary incinerator will be located offsite in industrial Cape Breton (see Appendix B). Materials to be incinerated include 120,000 tonnes (92,000 m^3) (*ex situ* volume) of sediment containing PCB materials from the Tar Ponds and 26,300 tonnes (13,500 m^3) of PAH contaminated sediment from the Coke Ovens site (Coke Ovens Brook sediment and Tar Cell contents).

The remaining contaminants will be treated in place. The top 1 to 2 m of remaining sediment in the Tar Ponds will be treated using solidification and stabilization. The top 0.5 m of remaining contaminated soil at selected areas on the Coke Ovens site will be treated using landfarming, a form of bioremediation.

Both sites will then be encapsulated using engineered containment systems designed to prevent human and environmental exposure to contaminants, and to prevent the movement of contaminants off site. Containment at the Tar Ponds will consist of impervious vertical walls installed at various locations around the edges of the Tar Ponds, and an engineered cover consisting of a semi-impervious, reinforced, multi-layered soil barrier designed to limit water penetration and facilitate future site uses. Containment at the Coke Ovens site will include impervious vertical walls installed at various locations around the perimeter of the site, and a covering of soil designed to facilitate future uses of the site.

Final restoration and landscaping of both sites will be compatible with the natural surroundings and future use.

Containment systems require long term monitoring to ensure their continued effectiveness. The remediation plan includes provisions for long term monitoring of air quality, water quality, soil, sediment, biota, and the performance of the containment system, and long-term maintenance of the sites.

1.7.1 Rationale for the Proposed Remediation Plan

Subsequent to receipt of the RAER report and the JAG recommendation, which was based on this report, the government partners undertook a thorough review of the project options using the following criteria:

- Potential Health and Environmental Impacts;
- Remediation Risks;
- Technology Track Records;
- Public Acceptance;
- Economic and Social Benefits;
- Costs;
- Affordability;
- Project Duration;
- Long Term Operation and Maintenance Requirements; and
- Legal Implications.

The results of this review are reflected in the Project Description contained in the Memorandum of Agreement signed on 12 May 2004 by the Federal and Provincial Governments (see Appendix A), described in this report.

1.8 PHYSICAL WORKS COMPLETED TO DATE

Significant progress was made over the last decade in preparing the sites for remediation and in developing a technically sound and cost-effective remediation plan. Work completed to date includes:

- Contaminant Characterization and Delineation – Studies began in the early 1980s and carried on through 2004 (i.e., Phase I, II & III environmental site assessments; risk assessments; environmental screenings; air quality studies; hydrogeological, and geotechnical assessments; etc.). These studies characterized and delineated the types and extent of the contaminants.

- Installation of Ferry Street Cofferdam – The cofferdam was installed between North and South Tar Ponds in 1992 to stabilize water levels in the South Pond and to limit contamination from entering the North Pond.
- Removal and Processing of Contaminated Materials – Approximately 4,000 tonnes of material were dredged and transported through a 1.5 km pipeline from the South Tar Pond to an incinerator located along the northwest end of the SYSCO site in 1992-93. Due to design constraints associated with the transfer of the materials to the incinerator, the operation of this system was discontinued.
- Security of Sites – Security fencing and gates were installed at the Ferry Street Cofferdam, SYSCO and Coke Ovens sites during the1990s to prevent access to the sites. Installation of security fencing around the Tar Ponds was completed in 2000.
- Installation of Wash-down Facility – A vehicle wash-down facility was installed in 2001 on the Coke Ovens site for vehicle decontamination before leaving the site.
- Capping of Municipal Landfill – Work took place from July 2001 to October 2002 to control leachate, from the municipal landfill, from migrating onto the Coke Ovens site.
- Removal of By-products Building – The steel structure was demolished and removed from the Coke Ovens site in April 2002.
- Removal of Cooling Grids – The wood cooling grids were removed from the Coke Ovens site in May 2002.
- Removal of Sulphur Piles – Remaining sulphur piles were removed from the Coke Ovens site during May and June 2003.
- Removal of Coal and Coke Piles – Coal and coke piles were removed from the Coke Ovens site during November and December 2002.
- Interceptor Sewer Line Installation – A sewer line was installed during 2002 and 2003 to intercept sewage and prevent it from discharging into the South Tar Pond. The Interceptor Sewer will collect sewage and redirect it to Battery Point when construction of the sewage treatment plant is completed (Spring 2005).
- Stack Removal – Stacks #5 and #6 were dismantled and removed from the Coke Ovens site from June to September 2002
- Cleaning of Benzol Tank – Residual material was cleaned from inside the tank on the Coke Ovens site in July 2003. The tank was inspected for structural integrity and remains on-site for possible future storage use during the remediation activities.
- Removal of Miscellaneous Debris – Miscellaneous surface debris (e.g., brick, steel, etc.) was removed from the Coke Ovens site during July and August 2003.
- Removal of Contents from Domtar Tank – Removal of liquid product and solids from the Domtar tank on the Coke Ovens site was initiated July 2003 and is scheduled to be complete in early 2005.

1.9 PROPOSED PREVENTATIVE WORKS

Four projects to reduce contaminant migration off the Tar Ponds and Coke Ovens sites are currently underway or in the detailed engineering design phase. It is anticipated that these projects will be completed in 2005/2006.

- Realignment of Coke Ovens Brook – Coke Ovens Brook will be realigned to an uncontaminated area. A final design of the Coke Ovens Brook realignment is currently underway.
- Removal of Cooling Pond – The Cooling Pond, behind SYSCO's General Office Building on Inglis Street and close to the Tar Ponds, will be removed and the site cleaned up. A preliminary design of the Cooling Pond Removal is currently underway.
- Installation of North Pond Cofferdam at Tar Pond Entrance – A cofferdam is to be constructed at the entrance to Muggah Creek near Battery Point. The purpose of the cofferdam is to control movement of contaminated material into Sydney Harbour. An options analysis and preliminary design is currently underway.
- Relocating the Victoria Road Water Main (Coke Ovens site) – The water main serving the Whitney Pier area is currently located in a contaminated area. This watermain will be relocated to an uncontaminated area. The watermain design is currently underway.

These 4 projects are not part of the Project Description and will be individually assessed in accordance with *CEAA*.

2.0 ENVIRONMENTAL DESCRIPTION

This section provides a description of the environmental setting in the area of and surrounding the Tar Ponds and Coke Ovens sites.

A description of the existing environment is necessary for 4 reasons:

- to determine which resources may be at risk from the proposed Project;
- to provide a baseline for identifying environmental change in the future;
- to assist in project design initiatives; and
- to assist in evaluating effects of the project on the environment.

The description of the existing environment is based upon available resource information from existing data and resource managers.

A detailed existing environment study is currently being prepared in anticipation of EA requirements.

2.1 BIOPHYSICAL ENVIRONMENT

2.1.1 Geography and Topography

The Project Area falls within the Carboniferous Lowlands region of Nova Scotia, and more specifically within the Sydney Coalfield subunit. The topography of the area is considered generally low with very little relief (NSM, 1996).

The general area is underlain by the Pictou-Morien geological region, which consists of Late Carboniferous sandstone and siltstone, containing numerous seams of coal. The geology is overlain by well-drained Shulie Soils, composed of stony, sandy loam tills (NSM, 1996).

The following sections provide site-specific details for both the Tar Ponds and the Coke Ovens sites.

2.1.1.1 Sydney Tar Ponds

The Sydney Tar Ponds (see Figure 1.4) is essentially the Muggah Creek Estuary, which consists of both the North and South Tar Ponds and adjacent shoreline areas. The watershed is approximately 1.8 km long from its mouth at Battery Point to the headwaters in Wash Brook. The widest points in the North and South Ponds are 200 m and 400 m, respectively. The watershed is orientated northwest - southeast and the mouth of the creek lies to the west. The drainage pattern is dendritic and the slope does not exceed 30%.

It is estimated that the Tar Ponds contain over 700,000 tonnes of PAH, PCB, heavy metal, and various organic, contaminated sediments over the past 100 years of industrial land use in Sydney. The sediment is described as being loose, black, odourous, and un-consolidated.

Shoreline areas surrounding the Tar Ponds include the West Shoreline, the East Shoreline and the Southeast Shoreline.

North Tar Pond

The North Pond is bounded to the north by Sydney Harbour, the east by the East Shoreline and the SYSCO Steel Plant, the south by the Ferry Street cofferdam, and to the west by the West Shoreline and the railyards.

The North Pond is an estuary of Sydney Harbour and is therefore susceptible to tidal action and is mainly saline. Water depths are relatively shallow, averaging less than 0.5 m below geodetic datum, and a maximum depth of 1.7 m below geodetic datum at the entrance to Sydney Harbour. The underwater stratigraphy includes contaminated sediments down to a depth of 4.9 m in places, till (compact silt sand and gravel) and silty sand approximately 1 m thick, and bedrock (mudstone and shale) ranging up to 6.4 m thick (JDAC, 2001b).

Historically, the North Pond has been a discharge area for raw sewage. In 1990, O'Halloran Campbell documented approximately 17 outfalls (CBCL, 1999) discharging into the North Pond. The 2002 Contaminant Loading Study identified a total of 21 outfalls (JDAC, 2002a). Twenty of these outfalls were located along the west shoreline from Battery Point to Ferry Street, and only one outfall was located on the east shoreline near the Ferry Street Cofferdam. A new interceptor sewer line was installed in 2003 in the Sydney area to collect the raw sewage and divert it to a new sewage treatment plant, which is currently under construction at Battery Point.

South Tar Pond

The South Pond is bounded to the north by the Ferry Street cofferdam; to the east by Coke Ovens Brook, and the East and Southeast Shoreline areas; the south by Wash Brook; and the west by the West Shoreline area.

The South Pond, which forms the southern portion of the watershed, is no longer part of the original estuary since the Ferry Street Cofferdam was constructed. The cofferdam is used to control water levels within the South Pond and prevent contaminated sediments from migrating into the North Pond. Coke Ovens Brook and Wash Brook are the 2 main freshwater sources that drain into the South Pond. Other freshwater sources include, storm water drainage, and groundwater recharge from surrounding areas. The pond is periodically influenced by tidal action when the control weir is lowered.

In addition to the North Pond, the South Pond has also been a discharge area for raw sewage. In 1990, O'Halloran Campbell documented approximately 19 sanitary and storm sewer outfalls that emptied into the South Pond (CBCL, 1999). The Contaminant Loading Study identified 26 outfalls (JDAC, 2002a). Of these, 11 outfalls were located along the west shoreline, and 15 were located along the east shoreline. Sewage from these outfalls will be collected by the new interceptor sewer line and diverted towards the new sewage treatment plant being constructed at Battery Point.

West Shoreline

The West Shoreline area covers approximately 36 hectares of land from Battery Point (northern tip) all the way past Prince Street (west of Wash Brook) to the south. There are 4 distinct geographic regions along the West Shoreline including, Battery Point, North Pond, South Pond, and Wash Brook. Each of the 4 areas are relatively flat elevations ranging between 1 to 3 metres above sea level (masl), with the highest elevation of 5 masl located at Battery Point.

Overburden at each of the areas ranged between 2.6 and 8.2 m and consisted of a thin topsoil layer (5 to 20 cm) on top of 3 possible layers of fill (up to 3 m); native till (1.2 to 6.4 m) consisting of reddish-brown compact sandy silt to silty clay; and subsequently bedrock.

The most common fill included brown silty sand to sand and gravel and could be classified as reworked till. The second fill unit included sandy fill consisting of ash, slag, coal fines and/or wood debris. The least common fill type was black silty sediment located near a former swamp area.

Bedrock is from the Point Edward Formation of the Canso Group, and is comprised of reddish-brown mudstone with mixed layers of siltstone and sandstone and is highly fractured. Top of bedrock exists between 2.5 and 6.7 m below sea level.

Surface water in the West Shoreline area includes Sydney Harbour, North and South Tar Ponds, and Wash Brook, which flows north into the South Pond. Groundwater flow (regional) is generally to the northeast towards the Tar Ponds (JDAC, 2001a).

East Shoreline

The East Shoreline area covers approximately 25 hectares of land, from the mouth of Sydney Harbour, along the full length of the North Pond and a portion of the South Pond, to Coke Ovens Brook. This shoreline area has historically been infilled with slag material resulting from the steel industry. There are 2 distinct geographic areas here including the High Dump Area (HDA) (northern portion) and the remaining shoreline areas (south to Coke Ovens Brook).

The HDA is very hilly (ranging between 7.3 and 22.5 masl) including the high dump area which plateaus at around 24 masl and drops steeply towards the North Pond shoreline at 4 masl. The remaining low-lying shoreline area (ranging between 5.1 and 6.2 masl) includes a large in-ground cooling pond with timber walls that was used to capture effluent from the steel mill for cooling purposes prior to release into the ponds.

The overburden thickness varies from 15 m thickness along the shoreline to 34 m thickness in the High Dump Area. The overburden consists of a thin layer of topsoil (5 to 20 cm), and 1 to 3 types of fill material (slag, estuarine and silty sand to silty gravel).

The fill material in the high dump area consists mainly of a heterogeneous mixture of slag fill which appeared to be dark gray to black and contained sand and gravel, slag, construction debris, coke pieces, coal, pig iron and occasional cobbles and gravel. The slag fill has a thickness of 0.1 to 25 m in the high dump area, and 0.45 to 11 m along the shoreline.

Bedrock is consistent with that found along the West Shoreline and exists between 4 and 11 m below sea level. Groundwater flow (regional) is generally to the southwest towards the Tar Ponds. Surface water features include Sydney Harbour, North and South Tar Ponds, Coke Ovens Brook and the in-ground cooling pond that was historically used to treat industrial effluent. Coke Ovens Brook flows to the southwest into the South Tar Pond (JDAC, 2001a).

Southeast Shoreline

The Southeast Shoreline area covers an area of approximately 27 hectares between the Coke Ovens Brook Connector and Wash Brook, and includes the land between Terminal Road and Prince Street. There are 3 distinct geographic areas here including the shoreline areas of the

South Pond and Wash Brook; the eastern portion adjacent to the Coke Ovens Brook Connector; and the Shaw Brick area that is located east of Inglis Street. Beneath these 3 areas is the location of the former municipal dump that was used during the early 1900's (CBCL, 1999).

The topography of the Southeast Shoreline generally increases from west to east. The shoreline areas are hilly and ranges in elevation from 1 to 9 masl. The eastern portion is gently sloping with elevations ranging from 6 to 10 masl with terraces occurring above the Coke Ovens Brook. Finally, the Shaw Brick area is flat to gently sloping at an average elevation of 10 masl.

The average overburden thickness throughout the area varies from 5 to 9 m in depth. The overburden material consists of a thin layer of topsoil (5 cm to 20 cm), and 1 to 3 types of fill materials (ash, coal fines, slag and/or debris; PAH contaminated sediments similar those found in Muggah Creek; and silty sand to sandy silt) overlying the native till.

Generally, the top layer of fill east of the eastern portion (east of Inglis Street) consists of gray to black silty sand to sandy silt containing ash, slag, coal fines and/or debris. The fill layer has an average thickness of 7.3 m thick. The shoreline area (west of Inglis Street) consists of a dark silty layer containing coal tar and ranges in thickness between 0.4 and 2.7 m. The native till layer is brown compact silty sand to sandy silt and ranged in thickness between 1.2 and 5.6 m. Much of the debris in this area is associated with the location of the former municipal dump (CBCL, 1999).

Bedrock is from the Point Edward Formation of the Canso Group, and is comprised of reddish-brown mudstone with layers of siltstone, sandstone, and shale. The bedrock is highly fractured. Bedrock exists between 2.5 and 6.7 m below sea level.

Surface water in the Southeast Shoreline area is limited to the South Tar Pond, Wash Brook, which flows north into the South Pond; and Coke Ovens Brook, which flows southwest into the South Tar Pond. Groundwater flow (regional) is generally to the west-northwest direction towards the South Tar Pond (JDAC, 2001a).

2.1.1.2 Coke Ovens

The valley in which the Coke Ovens site (see Figure 1.3) is located is relatively flat, with an approximate width of 700 m, with a gradual slope westward (5 to 10%). The topographic highs are located in the east (20 masl) and the topographic lows in the west (19 masl).

The valley is bounded by topographic highs to the north and south, which reach heights of 76 masl to 60 masl, respectively. There are 2 ridges that cross the valley floor at right angles, and are located immediately to the east and west of the Coke Ovens site and rise to approximately 25 masl. The ridge located to the east of the site crosses the entire valley and appears to be bedrock controlled, which is depicted by the numerous outcrops. The west ridge of the site originates off the south flank of the valley and extends half way across the valley floor. The west ridge, like the east ridge, appears to be bedrock controlled and has 6 to 7 m of till and weathered bedrock overlying the ridge, therefore, the relief in the region is bedrock controlled with only a thin drift cover.

The Coke Ovens site drainage is part of the Coke Ovens Brook watershed, which encompasses 8.4 km^2 and empties into the South Tar Pond to the west-southwest. The watershed is orientated north-south, parallel with the bedrock strike. The drainage pattern is dendritic and the topographic gradient is <1%.

2.1.2 Atmospheric Conditions

All migrating North America weather systems usually end up either over or near Atlantic Canada. As a consequence, the number and frequency of low-pressure systems crossing the area are higher in Atlantic Canada than in any other part of the country. In fact, air masses originating from the Arctic to the Gulf of Mexico may, at one time or another, influence weather conditions over the Atlantic Provinces (Dzikowski et al., 1985).

The pattern of weather systems brings prevailing west to south winds to the region. These winds bring air from the interior of the continent to the Atlantic Region. The frequent passing of low-pressure systems, with their associated weather, combined with the Atlantic Province's maritime location, provides the region with ample precipitation. In particular, the southern coast of Cape Breton, including the Sydney area, has one of the highest annual precipitation levels in the Atlantic Region (Dzikowski et al., 1985).

A wide temperature range characterizes a continental climate. Although the Atlantic Provinces have a large annual temperature variation, areas near the coast have a reduced temperature range as a result of the ocean supplying heat in the winter and cooling in the summer. This means that the climate of the Atlantic Provinces is characterized as a modified continental type (Dzikowski et al., 1985).

Climate normals (30-year averages) for the 1971 to 2000 time period have been obtained from Environment Canada from the principal weather station located at the Sydney Airport, and are summarized in the following paragraphs.

2.1.2.1 Temperature

Temperature normals from the Sydney Airport (1971-2000) indicate that the annual daily mean temperature is 5.5°C. The annual mean daily maximum temperature is 10.1°C and the annual mean daily minimum temperature is 1.0°C (EC, 2004).

2.1.2.2 Precipitation

The total annual mean for precipitation for the Sydney Station is 1504.9 mm. The total annual mean is defined as the total rainfall plus water equivalent of snowfall. The total mean snowfall is 298.3 cm (EC, 2004).

2.1.2.3 Fog

Climate normal data for fog was not available for the 1971-2000 data set. Fog data is, however available for the 1961 to 1990 dataset and has been included in this section. A review of the 30-year (1961-1990) climate normals from the Sydney Airport weather station indicates that this area receives an average of 80 days with fog a year. Fog is most often observed in the months of May, June and July with 11, 10, and 11 days of fog recorded on average, respectively. The months in which fog is least observed December, January and February, each with 4 days of fog recorded on average. In the Sydney area fog is recorded for more than 20% of days per year.

2.1.2.4 Wind

A summary of 1971 to 2000 wind information for the Sydney Airport weather station is provided below.

Winds are predominantly from the southwest quadrant. During summer months, winds are predominantly from the south and southwest directions. In winter, winds frequently move from the west directions. Winds are predominantly from the southeast, south and southwest during storm events. Winds from the east quadrant have the lowest frequency of occurrence overall.

The average annual wind speed (all directions) is 18.6 km/hr. Winds are generally strongest in the winter. Maximum hourly speeds of 97 km/hr were recorded in October, December and March with maximum gust speeds of 161 km/hr documented in December at the Sydney Airport Weather Station.

It should be noted that over the past few years there appears to be more frequent extreme weather events in the Atlantic Region. Recently, Nova Scotia has been subjected to drought, heavy precipitation events and a major landfall hurricane, Hurricane Juan. Environment Canada has indicated that throughout their use of climate data available and sophisticated climate system models, extreme events such as frequent drought and local severe storms are increasing and projected to increase throughout the next century. Future tropical events are projected to be more intense with climate change. Projections of global warming include a warming oven and hence indicated that such a source of energy will continue to intensify tropical features such as Hurricane Juan far beyond the level that has been seen historically (EC, 2004).

The following section provides a more detailed discussion of weather data collected at the 2 project weather stations for the year 2003 with comparisons to the 1971 to 2000 climate normal data for the Sydney Airport weather station.

As a component of the a site-specific ambient air monitoring program (AAMP), wind speed and direction data were collected hourly at 2 locations: the former Public Information Display Centre (PIDC) site located off Terminal Road, S of the South Tar Pond, and the Coke Ovens Project Weather Station located at the SE perimeter of the Coke Ovens site. A review of the weather data of these 2 project weather stations indicated that winds are most frequent from the southwest quadrant for both locations. This trend is also observed for the 1971 to 2000 30-year climate normal data for the Sydney Airport weather station.

2.1.2.5 Noise

Both the Tar Ponds and Coke Ovens sites are located in the downtown Sydney area. The areas surrounding these sites are a mixture of residential, commercial and industrial properties that include moderate to high volume traffic on roadways, trucking operations, a rail maintenance and storage facility, petroleum bulk station, municipal landfill, car dealership and a materials handling facility. All of these activities contribute noise to the areas surrounding both sites.

2.1.2.6 Air Quality

Air quality has been monitored at the Tar Ponds and Coke Ovens site and surrounding areas for several years through the Ambient Air Monitoring Program (AAMP) and National Air Pollution

Surveillance (NAPS) Network. Tables 2.1 and 2.2 enable a comparison for both criteria pollutant data and VOC/PAH data for some 10 NAPS sites outside of Sydney, as well as one in Sydney, with the 6 AAMP sites reported herein. The NAPS sites were chosen somewhat randomly, with the limitation of finding sites that had reasonably recent and comprehensive data.

TABLE 2.1 Comparison of Annual Averages - Criteria Pollutants

Location	Parameter			
	PM$_{2.5}$ (µg/m^3) Annual Average	PM$_{10}$ (µg/m^3) Annual Average	TSP (µg/m^3) Annual Average	O$_3$ (ppb) Annual Average
Canada-Wide Standard	30 µg/m^3 (24-hour average)	--	--	65 ppb (8-hour average)
Nova Scotia Air Quality Objective	--	--	70 µg/m^3 (annual average)	--
British Columbia Standard	--	50 µg/m^3 (24-hour average)	60 µg/m^3 (annual average)	--
Interim Separation Zone Criteria	--	25 µg/m^3 (annual average)	--	--
Sydney	NA	18 - 34 (9) (MR)	26 - 48 (MR)	26
AAMP - Victoria Road	--	14.2	30.9	--
AAMP - Frederick Street	--	18.6	41.2	--
AAMP - Henry Street	6.52	--	26.1	--
AAMP - Kings Road	5.71	--	--	--
AAMP - Intercolonial Street	6.14	--	--	--
AAMP - DesBarres Street	--	14.7	--	--
St. John's	5	NA	14 - 49 (MR)	27
Kejimkujik, NS	5	NA	NA	32
Halifax	6[4]	NA	NA	23
Saint John	6	14	7 - 67 (8)[3] (MR)	24
Montreal	9	NA	19 (10)	25
Montreal	NA	25 (11)	31 - 64[5] (MR)	22
Ottawa	NA	NA	16 - 67 (11) (MR)	25
Toronto	9	21	27 - 54[2] (MR)	22
Toronto	9 (11)	NA	27 - 57[6] (MR)	24
Hamilton	13 (10)	24 (10)	33 - 94[6] (MR)	20
Windsor	12 (10)	23	34 - 97[6] (MR)	20
Regina	8	40 (11)	11 - 66[5] (MR)	13
Edmonton	7	16 - 28 (8) (MR)	21 – 82[5] (MR)	22
Vancouver	NA	14	NA	14

Notes: [1] 1998 [2] 2001 [3] 1993 [4] 1996
[5] 1997 [6] 1999 [7] 2002
( ) indicates number of months for which data is available
NA = Not Available
Code = NAPS Identifier
MR = Monthly Range

TABLE 2.2 Comparison of Annual Averages - VOCs / PAHs

Location	Parameter						
	Benzene (µg/m^3)	Toluene (µg/m^3)	Ethylbenzene (µg/m^3)	Xylenes (µg/m^3)	Naphthalene (µg/m^3)	Benzo(a)pyrene (ng/m^3)	Total PAH (ng/m^3)
	Annual Average	Annual Average	Annual Average	Annual Average	Annual Average	Annual Average	Annual Average
Ontario Standard		2000 µg/m^3 24-hour average	1000 µg/m^3 24-hour average	2300 µg/m^3 24-hour average	22,500 ng/m^3 24-hour average	0.3 ng/m^3 24-hour average	--
Alberta Standard	30 µg/m^3 1-hour average	--	--	--	--	--	--
Interim Separation Zone Criteria	7 µg/m^3 annual average	760 µg/m^3 annual average	200 µg/m^3 annual average	36 µg/m^3 annual average	3 µg/m^3 annual average	22.4 µg/m^3 annual average	--
Sydney	NA	NA	NA	NA	NA	NA	NA
AAMP - Victoria Road	1.6	1.2	1	4	1.4 (ng/m^3)	0.14	15.8
AAMP - Frederick Street	1.6	1.4	0.8	2	2.0 (ng/m^3)	0.13	37
AAMP - Henry Street	1.7	1.6	1.9	11	1.8 (ng/m^3)	0.23	21.6
AAMP - Kings Road	0.99	1	0.5	1.2	1.0 (ng/m^3)	0.11	9
AAMP - Intercolonial Street	2	2	0.8	2.1	1.2 (ng/m^3)	0.18	21
AAMP - DesBarres Street	1.5	0.7	0.7	1.3	1.5 (ng/m^3)	0.2	18
St. John's	0.9	2.4	0.4	1.3	0.1	0.0 (4)^3 (MR)	4.64
Kejimkujik, NS	0.3	0.2	0	0	0	0	0.8
Halifax	1.6 (11)	3.8 (11)	0.7 (11)	2.3 (11)	0.2 (11)	0.0 (2)^5 (MR)	23.8 - 35.3 (2)^4 (MR)
Saint John	0.4 - 2.0 (9) (MR)	2.1 - 6.5 (9) (MR)	0.2 - 0.8 (9) (MR)	0.5 - 2.3 (9) (MR)	0.3 - 0.3 (9) (MR)	0.0 (2) (MR)	11.2 - 17.9 (2) (MR)
Montreal	1.5	4.4	0.7	2.4	0.2	0.0 - 0.1 (5) (MR)	9.6 - 18.8 (5) (MR)
Montreal	5.5	6.8	1.5	7	0.2	NA	NA
Ottawa	1.4	4.1	0.7	1.9	0.2	NA	NA
Toronto	1	4.1	0.6	1	0.6	NA	NA
Toronto	1.4 - 2.5 (5)	4.9 - 8.6 (5) (MR)	0.9 - 1.3 (5) (MR)	2.7 - 4.1 (5) (MR)	0.1 - 0.7 (5) (MR)	NA	NA
Hamilton	1.5 - 3.0 (8) (MR)	2.5 - 10.3 (8) (MR)	0.5 - 1.4 (8) (MR)	1.4 - 4.3 (8) (MR)	0.3 - 1.0 (8) (MR)	0.3^3 (9)	59.54
Windsor	1.5 - 1.8 (4) (MR)	1.8 - 4.8 (4) (MR)	0.3 - 0.7 (4) (MR)	0.7 - 2.2 (4) (MR)	0.5 - 0.8 (4) (MR)	0.2^3 (7)	26.7 (10)^4
Regina	1.5 (11)	3.9 (11)	0.6 (11)	2.1 (11)	0.4 (11)	NA	NA
Edmonton	1.8	3.4	0.6	2.2	0.1	0.0 - 0.1 (5) (MR)	11.9 - 30.8 (5) (MR)
Vancouver	1.1	4.7	0.7	2.4	0.2	NA	NA

Notes: [1]1998 [2]1993 [3]2002
[4]2001 [5]1995 [6]1992
( ) indicates number of months for which data is available
MR = Monthly Range
AA = Annual Average
NA = Not Available
Code = NAPS Identifier
ng (nanogram) = 1/1000 of a µg (microgram)

In reviewing these tables, it should be noted that the methodologies, quality assurance/quality control and method detection limits might vary, not only between the AAMP program and the NAPS sites, but also amongst the NAPS sites themselves. This is due not only to program differences, but also to field operations being conducted by differing organizations/staff. The NAPS program is, however, acknowledged to be a well-designed and controlled evaluation of air quality nationwide. Thus the data presented allows the reader to draw reasonable conclusions in comparing monitored air quality data from the AAMP with similar data from the NAPS sites. If the annual averages for these parameters were close to regulatory limits/criteria, a more detailed investigation of procedural and equipment differences would be warranted; however, the monitored air quality is well below these limits. The reader will note that 2 sites are included for both Montreal and Toronto. This is done to emphasize the fact that, particularly for larger urban centers, numerous NAPS sites exist, since the air quality monitored at any one site cannot be said to represent fully the air quality of a particular region/city/area. Rather, the data is representative of that particular site. Nonetheless, particularly when considering an annual average, these data, taken in context, allow the reader to evaluate the results on a comparative basis.

The levels of various metals (particulate at the various NAPS sites) are not included herein, as the data is sparse, and, where some results are available, is quite dated).

The average annual particulate levels for this program as well as a number of NAPS sites are depicted in Table 2.1, as well as the data for ground-level ozone (only NAPS sites). As can be seen, $PM_{2.5}$ levels fall well within the norms for the selected NAPS sites, and indeed are more typical of the lower range of annual averages. It should be noted that the Canada-wide standard shown for $PM_{2.5}$ is for a 24-hour average, since there is no annual criterion (which would be expected to be significantly lower).

The annual average levels for PM_{10} for the AAMP stations are similarly situated, being in the lower to mid-range of the NAPS sites depicted in the table. Again, the standard (British Columbia) portrayed for informational purposes is 50 $\mu g/m^3$ based on a 24-hour average - a regulatory limit for annual averages would be expected to be lower. The "Interim Separation Zone Criteria" adopted for this project when site activities are occurring is included for reference and is 25 $\mu g/m^3$ annual average. These criteria are conservative in nature, especially considering that site activities do not occur all year.

The TSP (Total Suspended Particulate) values shown compare quite favourably in terms of the monthly ranges shown for the NAPS sites. Unfortunately, the NAPS data is not formulated into annual averages, and, in addition, are somewhat dated. The use of TSP as an air quality parameter is diminishing, since the health implications are most strongly connected to smaller (inhalable/respirable) particles. The AAMP TSP averages are well within the Nova Scotia air quality objective.

Ground level ozone is not monitored as part of the AAMP program; however, given that it is measured at the Sydney NAPS station (Whitney Pier Fire Station), it is included as another indicator for comparing Sydney air quality to other areas. Again, no annual average regulatory limit has been established; however, the Sydney data falls squarely in the middle of that from the other sites. The Canada-wide numeric standard of 65 ppb, 8-hour average, is shown for informational purposes. It is believed that the bulk of ozone found in this region results from the long-range transport of air pollution from both the Northeastern United States, as well as from Ontario and Quebec. It is noteworthy that the National Park station, Kejimkujik, has $PM_{2.5}$ and ozone levels which are similar to all the NAPS sites (and indeed for the $PM_{2.5}$ levels found at the

AAMP stations), which may indicate that these annual averages are fundamentally indicative of ubiquitous background atmospheric levels resulting to some extent from long range transport.

In terms of the VOCs compared in Table 2.2, benzene, toluene, ethylbenzene and xylenes (BTEX), the annual averages for the AAMP sites were comparable to those found in those NAPS stations depicted which are in urban areas. Not surprisingly, the values for the Kejimkujik National Park station were lower than for the other NAPS sites, as the VOCs tend to reflect daily anthropogenic activities (vehicle emissions, industrial emissions, and fossil fuel-fired space heating emissions).

The average annual PAH levels found at the AAMP sites were, in terms of total PAH, comparable to the urban NAPS sites, although slightly higher than the norm when Hamilton and Windsor are excluded. The data from other areas is relatively sparse, and as expected, Kejimkujik results are significantly lower. Benzo(a)pyrene results for the AAMP sites are similar to those of Hamilton and Windsor, although somewhat higher than the data from other sites. However, the latter data is sparse, with only a few months reporting, and it is conceivable that the space-heating season is responsible, to some extent, for the differences.

The comparison of annual average levels for naphthalene is impossible to make, given the fact that the NAPS network monitors naphthalene as part of a suite of VOCs using canisters. This methodology apparently yields values that are not compatible with the methodology used for the AAMP, and these values actually exceed the total PAH values from the same stations. It would be prudent for some comparison studies to be undertaken, so that the use of appropriate methodology is ensure.

As has been noted, the air quality data (annual averages) as monitored for the AAMP appears to generally fall within the values demonstrated at various urban NAPS stations across Canada. However, one must be cautious in making such comparisons. The issues of possibly differing methodology, equipment and quality control techniques have been mentioned previously. Additionally, site-specific issues may give rise to apparently anomalous differences (or similarities) of monitored air quality, particularly when one examines shorter-term (1-hour, 24-hour) data. Nonetheless, annual averages tend to "smooth out" the differentials, and do a permit a subjective comparison of general air quality.

Given the nature of the Tar Ponds and Coke Oven sites, one might expect potential contributions to any/all of the parameters monitored; however, particular significance may be attached to VOCs and PAHs, since the release of these compounds, to a lesser or greater extent may be expected. Nonetheless, other significant contributory sources do exist, including space heating (coal/oil) and gasoline/diesel exhaust systems.

2.1.3 Bedrock and Surficial Geology

This section provides an overview of surficial and bedrock geology in the Sydney Area.

2.1.3.1 Surficial Geology

Surficial geology mapping of Nova Scotia (NSDNR, 1992) and Cape Breton Island (GSC, 1998) was reviewed to provide a general overview of the expected surficial geology for the general Sydney area. The surficial geology is comprised of a continuous veneer of Wisconsinian Age (12,000 years old) ground moraine deposits of stony till derived from local bedrock sources. The till contains a sandy matrix with numerous boulders. It is typically 2 to 4 m thick and is characterized by rapid drainage, erodability, stoniness, high water table and poor buffering capacity for acid rain. Thicker accumulations of this unit are found scattered outside the Study Area as crag-and-tail[1] and dumlinoid hill[2] features.

More recent deposits since the glaciation period, such as peat bogs/organic deposits and alluvial deposits would also be expected within the Study Area. However, due to the past industrial development and activity over most of the Coke Ovens site and Tar Ponds, most of these more recent natural deposits would be expected to have been removed during development or subsequently buried by fill placement.

2.1.3.2 Bedrock Geology

Bedrock mapping of the Sydney Basin (NSDNR, 1986) was reviewed to provide a general overview of the expected bedrock geology for the Study Area. The bedrock geology consists of the Paleozoic Age Carboniferous System. Within this System there is the older Canso Group Point Edward Formation, consisting of red and minor gray-green variably calcareous siltstone and sandstone and minor limestone, overlain by the younger Morien Group South Bar Formation, consisting of gray sandstone and pebbly sandstone with minor conglomerate and rare coal. The geologic contact is oriented approximately in a north - south direction, and is situated in the west part of the Coke Ovens site. The Point Edward Formation prevails west of this contact and is overlain by the South Bar Formation east of this contact.

The Study Area is situated on the east limb of the Bridgeport Anticline situated to the northeast. The bedding plane trends northwest – southeast and dips 7 to 10 degrees northeast. The Coxheath Fault, which is situated south of the Study Area, trends northeast – southwest.

2.1.4 Groundwater Resources

A review was undertaken of reports dating from 1990 to 2002 that document numerous groundwater studies focused on the Tar Ponds and Coke Ovens sites, involving the extensive drilling of boreholes and installation of monitoring wells, test pits, soil grain size analysis, hydraulic head testing (slug tests), elevation and location surveys, geophysical and geotechnical investigations, and groundwater level measurements. These programs were primarily undertaken by Acres (1989/ 1991, in Dillon-ADI, 2004), Nolan and Davis (1990) and JDAC (2001a, 2001b, 2002f).

2.1.4.1 Tar Ponds and Shoreline Areas

Based upon topography, groundwater flow is expected to be everywhere towards the Tar Ponds and away from nearby residential properties along the Western Shoreline. Similarly, the topography around the Eastern Shoreline, Southeastern Shoreline and the 'at right angles' juxtaposition of Tar Ponds leads investigators to assume that the localized shallow groundwater flow is likely from points of higher elevation inland from the shoreline of the Tar Ponds. The exceptions are the Cape Breton and Central Nova Scotia (CBCNS) rail yard and Battery Point, where there are groundwater highs in the center of the 2 areas, from which groundwater flows in all directions. The higher hydraulic head of groundwater farther inland from the CBCNS rail yard however, prevents groundwater from reaching residential properties (i.e., groundwater is diverted in a northerly and southerly direction towards the Tar Ponds after flowing easterly for some distance).

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[1] Crag-and-tail refers to a streamline hill or ridge, resulting from glaciation and consisting of a knob of resistant bedrock (the crag), with an elongated body (the tail) of more erodable bedrock, or till, or both, on its lee side.

[2] Drumliniod hill refers to a streamlined hill or ridge of glacial drift with the long axis paralleling the former direction of glacier flow.

Groundwater flow through the Eastern Shoreline in the overburden is southwesterly towards the Tar Ponds

Groundwater flow through the Southeast Shoreline (area east of Terminal Road) is generally thought to be west-northwesterly. Vertical upward gradients exist in this area, reflecting discharge conditions between the underlying bedrock and overburden into the Tar Ponds.

Contaminant Impact

The following discussion of Tar Ponds and Shoreline Areas contaminant impact was developed primarily from a review of Phase II and III work completed by JDAC (2001a, 2001b) and MGI (1998), supported by a review of the most recent 2003 monitoring results reported by Dillon - ADI (2004). There are many similarities between the 2003 results and those from the Phase II and III programs (JDAC, 2001a, 2001b). Essentially there has been no major change from the 2000/2001 results.

Elevated PAH compounds and metals were reported in surface/ subsurface soils and groundwater across the Eastern and Southeastern Shorelines, in concentrations exceeding referenced criteria. Exceedances were generally confined to fill units with visible ash, coal fines, or black estuarine sediments related to Tar Ponds PAH contamination. The deeper bedrock units contained groundwater that exhibited low level PAH contamination and minor BTEX levels. For the most part, the till is uncontaminated.

Previous studies identified significant exceedances of metals, PAH and VOC compounds in groundwater in the area of Wash Brook, adjacent to the Nova Scotia Power Inc. facility and a private salvage yard. However, there is no discussion of contaminant sources in the literature reviewed.

At the CBCNS rail yard, MGI reported free phase petroleum hydrocarbons, resembling fuel oil, 1.5 m thick, northwest of the maintenance building. A high vacuum extraction and treatment system was commissioned in 1999 to remediate the area, utilizing 21 extraction wells. The current status of the remediation is not known. There also are elevated dissolved phase petroleum hydrocarbons in an area just south of the maintenance building that was to be risk managed. The depth to groundwater is 1.5 to 2.5 m below grade at this site.

Along the Western Shoreline west of the North and South Tar Ponds, elevated petroleum hydrocarbons were reported adjacent to and west of the CBCNS rail yard and in an area north of Prince Street. There were no petroleum hydrocarbon impacts identified in groundwater. There were no issues identified for PCBs, PAHs and BTEX/TPH in groundwater. Several metals exceeded the referenced guidelines in groundwater.

2.1.4.2 Coke Ovens

The first documented efforts to investigate the subsurface groundwater environment were undertaken by Acres International Ltd. in 1984 and 1985, with a total of 26 monitoring wells almost exclusively at the Coke Ovens site CBCL and CRA, 1999). Additional wells were installed during the initial 10-year project to clean up the North and South Ponds, initiated in

November 1986. As part of that effort, intrusive work was undertaken of the 60-hectare Coke Ovens site in 1988-1989 to delineate the extent of groundwater contamination (NDAL/JWA, 1990). A total of 285 m of drilling was carried out with the installation and sampling of 24 monitoring wells at 16 sites. This work indicated the presence of inorganic and organic (HNC and PAH) plumes within the shallow bedrock aquifer under the site and off-site transport to the west under the SYSCO property (NDAL/JWA, 1990).

A number of further assessments were initiated that retained a focus on the upstream MAID/Sydney Landfill site and property to the north of the Coke Ovens site (NOCO). A Phase I ESA was undertaken for the Coke Ovens site in 1998 (CBCL and CRA, 1999), which led to follow-up Phase II and Phase III ESA programs that were completed in 2001 and 2002 respectively (JDAC 2001b, 2002e). The most recent groundwater sampling and monitoring program was undertaken by Dillon - ADI (2004) during 2003, utilizing the existing monitoring well network.

Overall, the site assessment defined basic hydrostratigraphic units present across the Coke Ovens site including the Morien Group bedrock (shallow and intermediate depths), fill and till, which control residual phase contamination and groundwater flow under the Coke Ovens site.

The evidence gathered suggests that groundwater movement within the Coke Ovens site is undoubtedly complex and largely influenced by remaining below grade man-made infrastructure and the infilling of surface depressions with fill of various descriptions, along with influences by Coke Ovens Brook and its tributaries. Although the apparent massive loading of coal tar and associated products employed at the Coke Ovens works over the past century will influence contaminant transport and rates of groundwater movement within the site, the general groundwater flow direction is east to west.

Groundwater flow and contaminant transport conditions of the Coke Ovens site were modeled by means of 3-dimensional groundwater flow and contaminant transport numerical models (JDAC, 2002e).

The numerical modeling effort by JDAC (2002e) viewed the entire complex as a single entity. The model predicts the effect of Coke Ovens Brook on groundwater flow within the fill, till, shallow and intermediate bedrock. Downward vertical gradients between the unconsolidated overburden are dominant over most of the Coke Ovens site in areas away from Coke Ovens Brook and its tributaries. Upward gradients are evident in the intermediate bedrock to shallow bedrock in those areas near the Coke Ovens Brook.

As a general rule, horizontal hydraulic gradients suggest that lateral groundwater flow within the fill, till and shallow bedrock is northwest to Coke Ovens Brook from all points south of it. Although shallow lateral flow appears to be westward along the east west length of Coke Ovens Brook from points north of it, this conclusion is largely based upon the east west lineal distribution of observation points available in this area. A southwesterly component of flow toward Coke Ovens Brook from areas north of it may be anticipated as demonstrated by the shallow southwest gradients identified in the Domtar area. The northwest area of the Domtar site may not be influenced by Coke Ovens Brook. Groundwater movement in this area is predicted to flow from the Domtar site toward the SYSCO site and beyond.

In conclusion, the groundwater modeling analysis and supporting data find that groundwater flow and the fate of dissolved contaminants contained within the fill, and shallow and intermediate bedrock that constitute the Coke Ovens site is primarily captured by Coke Ovens

Brook and its main tributaries (Domtar and Cagney Brooks) with the exception of the northern part of the Domtar site which directly contributes flow to the SYSCO property. Coke Ovens Brook is a significant feature and groundwater sink. Also, there is clearly an element of east to west groundwater flow within the shallow bedrock hydrostratigraphic unit along both flanks of the valley and from the MAID site to the Coke Ovens site.

Contaminant Impact

The following discussion of Coke Ovens site contaminant impact was developed from a review of Phase II and III work completed by JDAC (2002e) as well as groundwater monitoring and sampling conducted in 2003 by Dillon - ADI (2004).

Domtar Area

Coal tars are dense non-aqueous phase liquids (DNAPLs), which means that they are heavier than water and tend to sink until they reach a confining layer that restricts their downward migration. Coal tars were distributed in fill under and downgradient of the former tank farm, primary tar lagoon and tar storage tank. The till/fill interface was the key control on contaminant movement, originally directing flow to the south and west beneath Domtar Brook, a tributary of Coke Ovens Brook. Direct dissolved and free phase contaminant transport occurred to underlying bedrock at locations where the overlying till was absent. DNAPLs have been detected in a number of wells in the Domtar Area. The eastward dipping Canso/Morien contact may control the vertical migration of DNAPL through the rock.

In general, PAHs and BTEX compounds were the dominant groundwater contaminants and groundwater impacts in the shallow bedrock are likely the result of transport from overlying contaminated fills. PAH impacts were also reported in the shallow bedrock groundwater in the southwest corner of the site.

Off-site contaminant migration is to the west-southwest onto the SYSCO property and the Coke Ovens Brook system *via* groundwater in shallow bedrock. In the fill, contaminants migrate into Domtar Brook over much of the site, as well as westward onto SYSCO and Coke Ovens Brook Connector properties, and possibly beneath the Victoria Road Overpass.

Coal Pile Runway/Battery No.1

Coal tar (DNAPL) was identified in localized areas where there was no till. Coal tar was also found within portions of the Coke Plant Battery foundations. Coal tar has been found in stream bed sediments adjacent to the southwest corner of the site. Downward migration of coal tars is evident by the identification of DNAPL tars within the fractured Morien bedrock unit along the south central perimeter of the site.

Acidic drainage has developed due to the historic on-site coal stockpiling activities and has affected groundwater quality within the fill as well as within the shallow underlying bedrock. Discharge of fill impacted shallow groundwater was northward off-site into Frederick Street Brook. Ammonia was reported at elevated concentrations in groundwater within both the fill and bedrock, likely originating from the use of ammonia liquor from by-products processing. The shallow bedrock across the western portion of the site has been impacted by elevated metals and other inorganic parameters.

PAH and BTEX compounds were elevated in both the fill and bedrock groundwater, particularly at one locale near the western portion of the site where a major pocket of coal tar DNAPL was identified. PAH/BTEX concentrations in groundwater were much higher in the fill than the bedrock in the vicinity of this locale.

Coke Storage and By-Products Building

Both soils and groundwater of this area are impacted with high concentrations of TPH/BTEX, PAHs, and to a lesser extent metals. The areas most impacted are within fill materials and shallow groundwater in contact with fill and adjacent to sub-grade infrastructure. Specific concerns relate to a PAH and TPH/BTEX groundwater plume near the former By-Products Building and widespread coal tar impacts. Detectable creosote and/or hydrocarbons odours were noted in sub-surface soils throughout the area. Mobile coal tar was identified locally within fill materials.

The most impacted portions of the site include the northern portion of the former Coke Ovens Coke Batteries and the southwest area of former Coke Ovens Coke Storage extending northwest towards the former Benzol Plant. Contaminated groundwater associated within this area likely discharges into Coke Ovens Brook.

Benzol Plant and Tanks Area

Both soils and groundwater of this area are impacted with high concentrations of TPH/BTEX, PAHs, and to a lesser extent metals and inorganic parameters. The areas most impacted are within fill materials and shallow groundwater in contact with fill and adjacent to sub-grade infrastructure.

Three main areas of contaminated fill were identified with elevated concentrations of PAHs, TPH/BTEX, and some metals. These areas include: the southeastern section of the former Coke Ovens Benzol Plant; along the western portion of the Benzol Plant adjacent to Coke Ovens Brook; and within the former Benzol Tanks portion of the area. BTEX/PAH impact to the shallow fill/till and shallow bedrock extends throughout most of the former Benzol Plant and Tank areas. BTEX impacts (especially benzene) to the deep bedrock groundwater are apparent in the former Benzol Plant area. Generally, there is a trend to decreasing concentrations of contaminants with depth of groundwater. Contaminated groundwater from the Benzol Plant and Tanks Areas is expected to discharge into Coke Ovens Brook.

MAID Area

MAID Area groundwater impacts were from elevated major ions, trace and minor metals and Beta radiation, with only minor organic contaminants reported. The contaminant plume from the Maid Area migrates in a westerly direction centered directly below Coke Ovens Brook. At the point that it leaves the MAID Area, the plume is approximately 350 m wide and concentrated within the shallow bedrock at depths of around 5 m, but can extend to depths as great as 20 m.

Contaminant Loading from Groundwater

A contaminant loading study was completed by JDAC (2002 a), which evaluated contaminant mass loading contributions from groundwater and surface water sources to Muggah Creek. A portion of the contaminant loading to Muggah Creek results from substances in groundwater discharging directly into the North and South Ponds. Groundwater loading estimates were determined by means of the JDAC groundwater model (JDAC, 2002e) and by utilizing average groundwater concentrations of contaminants reported in the vicinity of the ponds. The 2002 groundwater model was modified to produce more conservative discharge data that accounted for annual seasonal variation in flows.

The total estimated groundwater loadings to the ponds were greater than 200 kg/year for copper and zinc and less than 20 kg/year for other metals. The estimated loading of mid-range hydrocarbons ($C_{10\text{-}32}$) was greater than 1000 kg/year. For low molecular weight PAHs, total loading was greater than 200 kg/year with naphthalene alone accounting for 79% of this mass. Medium and high molecular weight PAHs accounted for <20 kg/year.

2.1.5 Surface Water Resources

The drainage area of Muggah Creek is comprised of 2 sub-watersheds, Coke Ovens Brook (10.34 km^2) and Wash Brook (12.18 km^2). Surface waters in the watershed drain *via* municipal sewers and ditches to Wash Brook or Coke Ovens Brook and empty into the Tar Ponds

2.1.5.1 Coke Ovens Brook Watershed

The Coke Ovens Brook Watershed (COBW) comprises the northern portion of the Muggah Creek Watershed. The brook had its origins in the upper reaches of the COBW and drains through an urban and industrial landscape approximately 8.4 km^2 in area.

Mean natural annual flows have been calculated at 0.34 m^3/s, with mean annual flood and 100-year flows estimated at 6.2 and 12.8 m^3/s respectively (Acres, 1985). However, recent estimates in the 2004 Coke Ovens Brook Realignment Study using the OTTHYMO computer model estimated flows during the November 2000 storm event and a 100-year event to be 17.7 and 62.3 m^3/s respectively (Dillon-Franz, 2004).

The watercourses that drain into Coke Ovens Brook are:

- Whitney Pier Brook;
- Radar Brook;
- Frederick Street Brook;
- DOMTAR Brook;
- Incinerator Marsh;
- Cossitt Lake;
- Cagney Brook; and
- Prince Street Brook.

The following sections provide a summary of these watercourses (detailed descriptions are provided in CBCL, 1999).

Whitney Pier Brook

Whitney Pier Brook originates in a small marshy area to the north and flows through Whitney Pier to the Cape Breton Development Corporation Rail lines where it passes beneath the rails near the intersection of Frederick Street and Lingan Road. The brook remains in a culvert for approximately 180m, when it emerges and enters Coke Ovens Brook just before the Coke Ovens Brook flows under the Victoria Road overpass.

Radar Brook

Radar Brook originates in a small marshy area to the north where it flows through a largely forested area. At its lower end the Brook flows under the Cape Breton Development Corporation Railway (CBDCR) where it enters Coke Ovens Brook at the Northeast edge of the Municipal Landfill.

Frederick Street Brook

Frederick Street Brook originates at a spring-fed marsh area on the north side of the CBDCR. The brook intersects Whitney Pier Brook just before it passes under the rails near the intersection of Frederick Street and Lingan Road. This brook has an orange tint also visible on aerial photos. In the spring of 1998 surface water and sediment quality were tested for 68 metallic and inorganic parameters, 8 of which exceeded established guidelines for calcium, total dissolved solids, aluminum, manganese, silver, and zinc.

Domtar Brook

Domtar Brook originates in a small marshy area, flows through Whitney Pier, and passes underground through the CBDCR yard in the Domtar Area of the Coke Ovens site. The brook remains underground in a culvert for approximately 100 m as it flows under the former DOMTAR lagoon site. It then empties into the Coke Ovens Brook immediately upstream of the Victoria Road Overpass. Samples from DOMTAR Brook adjacent the Whitney Pier Memorial School were analyzed for the 1996 Britten Research Associates Study. Analyses indicated that the samples contained levels of aluminum, copper, iron, selenium, and zinc above the CCME guidelines for Freshwater Aquatic Life.

Incinerator Marsh

Incinerator Marsh is located in the southwestern corner of the municipal landfill. The marsh drains to the west into the MAID Pond, just before entering the Coke Ovens site. The Cape Breton Environmental Group carried out surface water testing around the landfill area during a 1999 study however, there were no samples taken from the marsh (CBEG, 1999).

Cossitt Lake

Cossitt Lake is located at the rear of the Cossitt Lake Industrial Park in the southeast of the City of Sydney. This lake is approximately 0.159 km^2 in size and drains into Cagney Brook.

Cagney Brook

Cagney Brook flows from Cossitt Lake through a developed residential area. It enters the Coke Ovens site through a culvert located at the southern perimeter. During the period of operation of the Coke Ovens, Cagney Brook was diverted north across the site *via* an underground culvert that emptied into Coke Ovens Brook. During recent remedial work to improve surface drainage on the site, a section of the Cagney Brook culvert was removed and a ditched channel constructed, allowing the waters of Cagney Brook to once again drain overland across the Coke

Ovens site. The ditch curves to the west to the area of the former Benzol plant where it turns to the north, entering Coke Ovens Brook just before the Victoria Road Overpass. General chemistry reports on samples taken in 1989 from the brook show that the only parameter tested that was above CCME remediation criteria for Freshwater Aquatic Life was iron.

Coke Ovens Brook

Coke Ovens Brook originates in the east approximately halfway along the north side of the Municipal Landfill. The brook is joined by the Incinerator Marsh tributary and Radar Brook and flows from east to west through the Coke Ovens site, joining with Frederick Street Brook, Whitney Pier Brook, DOMTAR Brook and Cagney Brook. The Coke Ovens Brook then flows just southeast of the SYSCO site and into Muggah Creek.

Three known constructed drains empty into the brook from the Coke Ovens site:

- A culvert draining the area to the south of the brook near the abandoned coal washing facility;
- A culvert draining the area to the north of the brook near the conveyor tunnel; and
- A culvert draining the perimeter of the Coke Ovens site.

A natural spring enters the brook form the vicinity of the Benzol plant. Several sewage outfalls enter the brook in the area of the Victoria Road Overpass.

Coke Ovens Brook now drains an area of approximately 8.4 km^2. Over much of its length the riparian habitat has been destroyed and replaced with channelized banks, debris and infill. It is unlikely that this is the original course of this brook as it has reportedly been channelized in the past. The brook has an estimated mean flow of 0.34 m^3/s (CBCL, 1999). As the brook traverses the Coke Ovens site, and in downstream reaches, certain portions of the streambed are visibly coated with tars. The entire streambed on the Coke Ovens site is covered with a bright orange precipitate.

Discharges from the MAID site immediately upstream of the Coke Ovens site discharges substantially impacted waters into Coke Ovens Brook. These discharges from the MAID site, coupled with the associated metal precipitates that blanket Coke Ovens Brook stream bed throughout the Coke Ovens site tend to mask all but the major trends in water quality.

The surface water-monitoring program reported on in Dillon-ADI (2004), indicates that the dominant contaminant loading comes through Coke Ovens Brook, as it receives discharges from the Coke Ovens, MAID landfill, raw sewage, and urban runoff.

2.1.5.2 Wash Brook Watershed

Wash Brook Watershed comprises the lower southern portion of the Muggah Creek Watershed and drains an industrial area of approximately 12.6 km^2. It contains Mud Lake, Gilholmes Lake, an unnamed brook, and Wash Brook. Wash Brook was determined to have no contaminant sources other than normal urban runoff (Dillon-ADI, 2004).

Mud Lake

Mud Lake is the most southern lake in the Muggah Creek Watershed. It is 0.45 km^2 in surface area and drains through an unnamed stream to Wash Brook.

Gilholmes Lake

Gilholmes Lake is the most eastern lake in the Muggah Creek Watershed and falls within the boundaries of the Department of National Defence property. It is approximately 0.25 km^2 in area and flows into Wash Brook.

Wash Brook

Wash Brook flows from south to north and through a residential landscape and empties into Muggah Creek. There are approximately 4 sanitary outfalls emptying directly into the watercourse. During the summer of 1995, ACAP-Cape Breton and others conducted an 8-week water quality monitoring study at 8 sampling stations on Wash Brook. Monitoring sites 1, 2 and 3 had levels of faecal coliform consistently in excess of 600 counts per 100 mL that exceeds the recommended levels for Total Body Contact (i.e. swimming). Monitoring sites 1, 2, and 3 were located closest to Muggah Creek. The high faecal coliform counts were attributed to the combined sanitary and storm sewer outfalls in this section of the stream.

2.1.5.3 Muggah Creek (Tar Ponds)

Coke Ovens Brook and Wash Brook empty into Muggah Creek (i.e., North and South Tar Ponds), a tidal estuary 33 ha in area, which then empties into the South Arm which then forms the Sydney Harbour. A large portion of the northern section of Muggah Creek (i.e., North Pond) has been infilled over the years from SYSCO operations. Ferry Street divides Muggah Creek into the North Pond and the South Pond.

Water levels between the 2 ponds are controlled by a flow control weir structure at Ferry Street (i.e., Ferry Street Cofferdam). It is estimated that at least 47 piped outfalls exist in the Creek area and that the estimated volume of sewage is 13 million L/day.

Current estimates indicate that the total quantity of contaminated sediments in the Tar Ponds is in the order of 700,000 tonnes. These sediments are contaminated with a combination of PAHs, PCBs, heavy metals, coal tar, and coal and coke fines.

2.1.6 Marine Environment

Sydney Harbour (see Figure 2.1) is a shallow Y- shaped inlet, which is up to 21 m deep, 21 km long and 3 km wide at its mouth (Stewart, 1996). Both arms slope gradually towards the sea and from the shore towards the center (Lee, 2002). The South Arm is about 10 km long, 1 km wide (Lee, 2002), and up to 17 to 19 m deep in the center, but forms a basin due to a shallow bar at its mouth, with depths at about 13 m. The North Arm including Northwest Arm becomes gradually shallower towards its head (OceanChem, 1984, in Stewart, 1996). It contains a shoal with about 7 m depth and an adjacent channel south of it near Point Edward with about 21 m depth. The waters are about 15 m deep where both arms of the Harbour join at Point Edward (Lee, 2002). Fine sediments accumulate in the harbour (Stewart, 1996).

Sydney Harbour receives freshwater from the Sydney River (average annual flow 6.1 m^3/sec), which enters at the head of the South Arm, from stormwater and sewer outfalls, as well as from several smaller watercourses (Stewart, 1996). Muggah Creek is the largest of these, entering into the South Arm. Frenchvale Brook and Leitches Brook enter at the head of the Northwest Arm. Sydney River has a peak flow of 21 m^3/sec in April and a minimum flow of about 5 m^3/sec in July and August (Gregory et al., 1993 in Lee, 2002).

2.1.6.1 Sediment Transport

The speeds of the currents in the South Arm are slow. Most of the time, the speed is less than 10 cm/sec, both in summer and in winter (Lee, 2002). Strong currents would be expected to increase the probability of resuspending bottom sediments, leading to sediment transport. Lee (2002) ran sediment transport models based on current meter data collected from October 2000 to May 2001 north of Muggah Creek. The bottom boundary layer transport model shows, that during this time period, only 4 events suspended more than 50 % of the sediments for a short period of time. Most of the time, below 20 % of the sediments becomes resuspended.

The flushing time for the inlet, as a whole, is 5.8 days, with peak tidal currents of 5 cm/sec and mean tidal currents of 3 cm/sec. The value for the South Arm is similar, while that for the Northwest Arm is 4.3 days (Gregory et al., 1993, in Stewart, 1996).

2.1.6.2 Physical Properties of the Sediments

According to Stewart (1996), sediments in protected coastal areas, such as bays and inlets, generally tend to be finer, have elevated organic carbon content and show chemical differences such as elevated metals and organic contents compared to offshore sediments. Also, they often show evidence of influence of chemical processes such as enhanced content of some metals, resulting from the lowered oxygen concentration (Stewart, 1996). Sediments in Sydney Harbour follow this observation

The sediments in Sydney Harbour vary with location. The shallow subtidal areas of both the South Arm and the Northwest Arm are characterized by relatively coarse sediments, with significant sand and gravel components. The deeper, central sediments consist mainly of silt and clays with elevated organic content: up to 7 % organic carbon (OceanChem, 1984, in Stewart, 1996). Due to the basin shape of the South Arm, deposition of particles increases here. Domestic sewage and industrial contaminants are the major contributors to the elevated organic concentrations in the South Arm sediments (OceanChem, 1984 in Stewart, 1996).

2.1.6.3 Contamination

Sydney Harbour is impacted by organic loading, metallic and organic contaminants and bacterial contamination like many industrial ports, but more severely due to the effluent from the Sydney Tar Ponds: PAH, PCB, metals and other toxic chemicals (Lee, 2002).

Sydney Harbour has traditionally been receiving waters and pollutants from a number of sources (Hildebrand, 1982, OceanChem, 1984, Vandermeulen, 1989, in Stewart 1996):

- Untreated domestic sewage from the City of Sydney (South Arm), and the Towns of Sydney Mines and North Sydney (Outer Harbour);
- Many smaller point sources; and

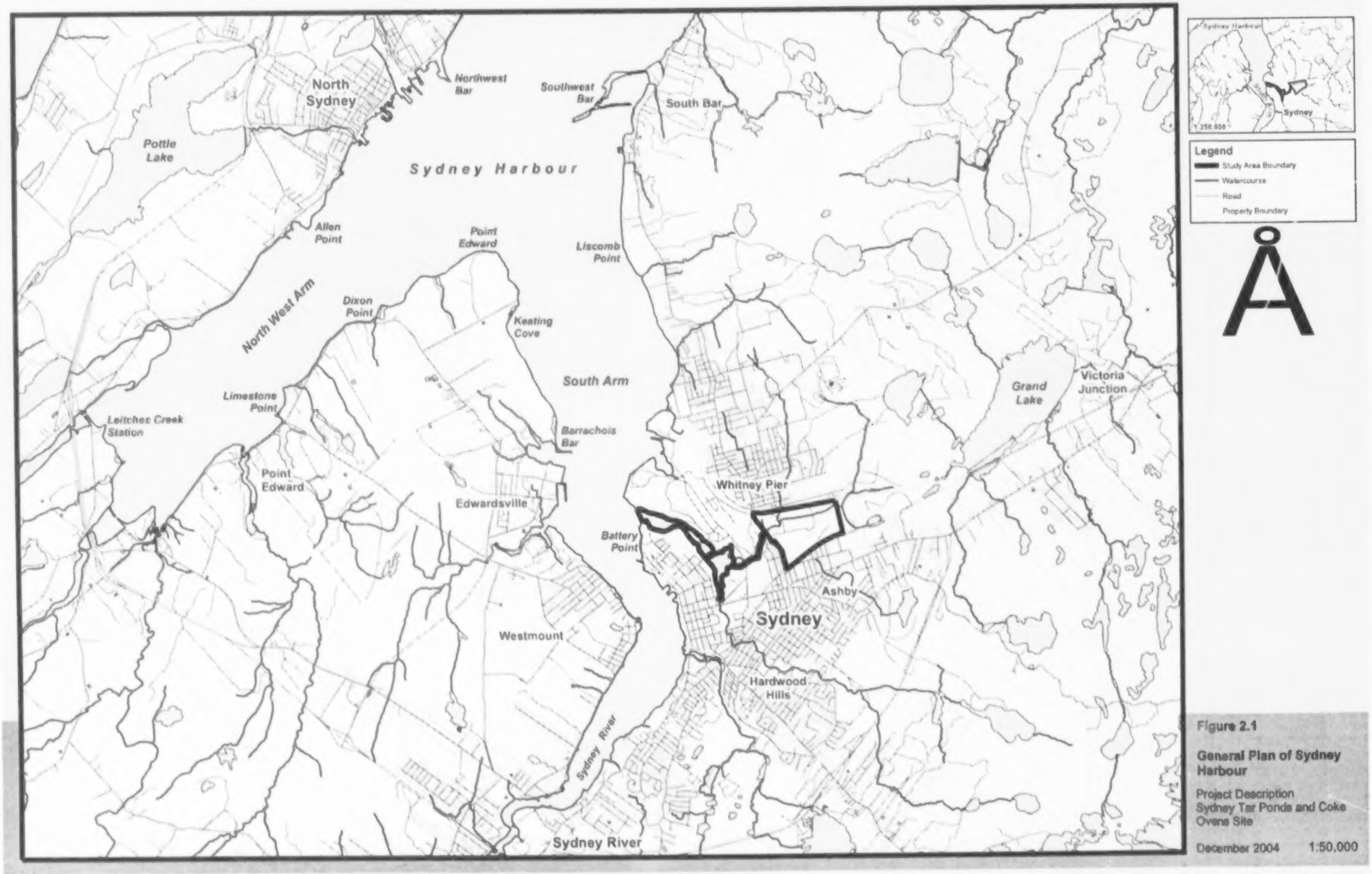
North Sydney
Northwest Bar
Southwest Bar
South Bar
Pottle Lake
Sydney Harbour
Allen Point
Point Edward
Liscomb Point
Dixon Point
Keating Cove
North West Arm
South Arm
Limestone Point
Leitches Creek Station
Barrachois Bar
Point Edward
Edwardsville
Whitney Pier
Battery Point
Ashby
Sydney
Westmount
Hardwood Hills
Sydney River
Sydney River
Grand Lake
Victoria Junction
Sydney Harbour
Sydney
1:250,000
Legend
Study Area Boundary
Watercourse
Road
Property Boundary

Figure 2.1

General Plan of Sydney Harbour

Project Description
Sydney Tar Ponds and Coke Ovens Site

December 2004 1:50,000

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- Major industries and commercial activities including shipping (coal, iron ore, steel, petroleum, petroleum products), marine transport, ship repair, fish processing, coal mining and processing facilities, and a major steel mill.

Effluents from the steel mill contained ammonia, iron, phenols, cyanide and phosphate. Effluents from the coke ovens, which were closed down in 1981 (Battery No. 5) and 1983 (Battery No. 6 – partial close down), contained ammonia, phenols, cyanide, thiocyanate, sulphide, oil and grease, benzene, chloroform, methylene chloride, toluene, PAHs and metals - effluents which have a high chemical and biological oxygen demand, and a high amount of suspended and dissolved solids (Hildebrand, 1982 and Vandermeulen, 1989, in Stewart, 1996). Both operations discharged into Muggah Creek. The steel plant also was a source of air emissions (TSP, SO_2 and PAHs) (Eaton et al., 1994 in Stewart, 1996), which could be deposited onto surrounding areas, eventually making their way into the harbour. A coal mining, treatment, and wash operation (Princess Colliery) were located on the western coast near the harbour mouth. Effluents contained elevated concentrations of iron, but other metals are no particular concern (Day et al., 1979 and Hildebrand, 1982, in Stewart, 1996).

Even though the steel plant and coke ovens are now shut down, PAHs and other coal tar derivatives still escape into the harbour. Also, PCBs, dumped by the general population and local industries into Muggah Creek, still enter Sydney Harbour (Vandermeulen 1989, and P. Lane and Associates, 1988-1990, in Stewart, 1996). An estimated 770 kg PAHs per year continue to flow into the South Arm from Muggah Creek (P. Lane and Associates, 1990 in Stewart, 1996).

Contaminants in Sediment

Organic as well as inorganic contaminants were detected in sediments and waters of Sydney Harbour. Elevated concentrations throughout the Harbour, with the highest levels were found in the Muggah Creek area (Zajdlik, 2000). The PAHs found in the harbour can originate from industrial and residential sources, as well as long- range transport (Lee, 2002). Many PAHs are highly reactive with particles. Therefore, most of the PAHs, which are deposited into the harbour, will soon accumulate in the sediments (Lee, 2002).

The Tar Ponds, the enlarged portion of the small tributary Muggah Creek, which empties into the South Arm of Sydney Harbour, have been recognized as the major source of coal tar hydrocarbons in the harbour. The Tar Ponds hold an estimated 700,000 tonnes of coal tar contaminated sediment, which equates to about 3,500 tonnes of PAHs as coal tar, as well as heavy metals (Matheson et al., 1983 in Lee, 2002). Both Muggah Creek and the Tar Ponds are tidal, resulting in a constant stream of PAH contaminated particles into the harbour. It has been estimated, that more than 50 tonnes of PAH-containing particles are discharged into the South Arm of the harbour during one tidal cycle in a 5-year extreme event (Lee, 2002). Lee (2002) calculated the total quantities of contaminants carried into Sydney Harbour: the total amount of PAHs is 289 kg/year, with more than 50 % of this contributed by Muggah Creek. This compares to calculations of 793 kg/year PAHs from Muggah Creek in the JDAC Tar Ponds risk assessment (2002, in Lee 2002) and 767 +/- 360 kg/year in P. Lane and Associates (1989, in Lee, 2002).

PAHs

Within Sydney Harbour, the highest concentrations of PAHs in sediments are found in the South Arm. Concentrations decrease towards the Outer Harbour/ mouth of the harbour (Zajdlik et al., 2000; Matheson et al., 1983 in Lee, 2002; Ernst et al., 1999). Ernst et al. (1999) find the PAH concentrations in sediment moderately correlated to distance from Muggah Creek in a Pearson Correlation Matrix test.

Concentrations larger than 200 µg/g in 1999 are reported in Lee (2002) in the South Arm close to Muggah Creek and in an area on the eastern shore of the South Arm about 2 to 3 km north of the creek, while concentration between 0 and 50 µg/g were found at the head of South Arm, the mouth of South Arm and the rest of the harbour. Concentrations above 500 µg/g were measured in Muggah Creek and subsurface sediments adjacent to the creek.

Concentrations as high as 178.4 µg/g were found just south of Battery Point (i.e., about 1 km south of the mouth of Muggah Creek) in samples collected in 1995, while the concentrations at the mouth of the harbour are as low as 0.06 to 0.35 µg/g. At the mouth of the South Arm, values of 31.7 µg/g (east side) and 13.18 µg/g (west side) and lower concentrations between the 2 sites were found (Ernst et al., 1999). The PAH concentrations found in sediments of the Northwest Arm are about 10 times lower than those found at the mouth of the South Arm (Ernst et al., 1999).

PCBs

Similar to the distribution of PAHs, the highest concentrations of PCBs again were found in the area close to the mouth of Muggah Creek, which is considered the source of the pollution (Zajdlik et al., 2000; Lee, 2002), but Ernst et al. (1999) qualify this conclusion (see below). In 1999, Lee (2002) found low PCB concentrations (0.05 µg/g) at the mouth of the South Arm, about 4 km north of Muggah Creek.

Ernst et al. (1999) found PCB concentrations in sediment depth of 0 to 2 cm ranging from non-detectable (i.e., 0.05 µg/g dry weight) at the mouth of the harbour and in the Northwest Arm, to a maximum of 21.9 µg/g at station 32 and 20.3 µg/g at station 31, which both are about 1,500 m south of the mouth of Muggah Creek. Stations at the mouth of Muggah Creek had concentrations about 10 times less than these maxima close to the east shore, and much less than this in the middle and the west side of the South Arm opposite of Muggah Creek. Ernst et al. (1999) state that this pattern would suggest that Muggah Creek is not the source of the general PCB contamination in the harbour (this suggestion is echoed in Lee, 2002, chapter 5), and also, that there is a more recent introduction of PCBs at Battery Point.

Metals

Ernst et al. (1999) in 1995 analyzed surface sediments for the metals such as aluminum, boron, copper, lead, chromium, manganese, nickel, zinc, strontium, titanium and calcium. They observe a significant negative correlation between concentration of the metals barium, chromium, copper, sodium, phosphorous, lead, vanadium, zinc and a few others and the distance from Muggah Creek, but also state that the overall distribution pattern suggests that Muggah Creek is not the only and may not even be the most important source of metals in Sydney Harbour. Zajdlik et al. (2002) find a gradient in the concentrations of the metals cadmium, zinc, nickel, copper, mercury, lead and arsenic from sampling stations at the Mouth of

Muggah Creek to the mouth of the Harbour about 11 km north of Muggah Creek, while chromium, zinc, and sulphides peak at a station about 2 km north of Muggah Creek.

Trace metal concentrations in surficial sediments collected by Lee (2002) with grab samplers in 1999 showed that the concentrations of bismuth, cadmium, copper, lead, mercury, molybdenum, silver and zinc are much higher in the South Arm than in the Northwest Arm and the Outer Harbour. The distribution of the metals in all areas is controlled by the accumulation of fine-grained alumosilicates and the anthropogenic contamination (Lee, 2002). While sewage is also a significant source of lead, zinc, bismuth, cadmium, etc, the distribution of sediments with high concentrations of these metals suggests that the tar ponds are a much more important source for lead and zinc. A third contributor to the lead, zinc, etc., pattern are the many small industrial sources in the area from Sydney to Whitney Pier (Lee, 2002).

Contaminants in Water

Water samples from 5 areas of Sydney Harbour were analyzed for dissolved and particulate metals (cadmium, copper, iron, lead, manganese, nickel, zinc), total Hg, nutrients, suspended particulate matter (SPM) and particulate organic contaminants. Temperature and salinity were also measured (Lee, 2002). The average dissolved concentrations for cadmium, copper, lead, nickel and zinc in all areas of the harbour during 1999-2000 are all lower than water quality guidelines. The concentrations vary over time, most likely due to changes in the amount of freshwater flowing into the harbour, which is lowest in July. Also, the concentrations show different spatial patterns depending on the metal. For example, copper (a sewage tracer) decreases with distance from the estuary, due to the inflow of water from Sydney River, while the concentrations of zinc are highest in the Central South Arm, indicating an industrial source.

The negative correlation between copper (and other metal) concentrations and salinity confirms the influence of fresh water on the concentrations (Lee, 2002). Lee (2002) states that concentrations of particulate metals were "generally not excessive" and similar or lower than concentrations found in harbour sediments. A study by O'Neill and Kieley (1992, in Stewart 1996) finds PAH concentrations of 0.1 to 1.0 µg/g in Harbour water.

Contaminants in Biota

Elevated concentrations of PAHs in biota have been reported for about 2 decades. Elevated levels of PAHs were detected in digestive glands and muscle meat of lobster (*Homarus americanus*) (Musial, 1986 in Lee, 2002; King, 1993 in Lee, 2002; Ernst et al.,1999), leading to the closure of the lobster fishery in the 1980, as well as in mussels (*Mytilus edulis* and *Modiolus modiolus*) (Ernst et al., 1999).

In 1995, PAH concentrations in cooked lobster meat ranged from 0.1 to 0.2 µg/g (non-detectable) to 0.15 µg/g (wet weight). PAH concentrations in uncooked digestive glands (hepatopancreas) ranged from non-detectable to 13.67 µg/g (Ernst et al., 1999). The highest concentrations in lobster digestive glands were found closest to Muggah Creek.

Ernst et al., (1999) also found elevated PAH concentrations in mussels collected in 1995: 0.78 µg/g to 5.013 µg/g. The highest concentrations were found in mussels collected at Battery Point, immediately south of Muggah Creek (4.484 µg/g), and at Dobson's Point, about 1.5 km south of Muggah Creek (5.013 µg/g). The concentrations decrease statistically significant with distance from Muggah Creek, which was also found in studies in 1981 and 1986.

Elevated activities of the Mixed Function Oxidase Enzyme System (MFO) were found in Winter flounder (*Pleuronectes americanus*) caught in Sydney Harbour, which appear to be correlated to "a PAH gradient" in sediments (Vandermeulen, in Lee 2002).

2.1.6.4 Benthic Communities

The benthic communities in Sydney Harbour have been investigated in few studies: Wendland (1979 in Lee, 2002), P. Lane and Associates (1988,1989 in Lee, 2002), Zajdlik et al. (2000) and Lee (2002). The study by Wendland focused on the South Arm, while the other studies covered the whole harbour. Lee repeated sampling at locations used in earlier studies, in addition to newly chosen locations.

The biological communities found in Sydney Harbour are 'comparable' to those found in other areas of the Atlantic Coast of Nova Scotia (Stewart, 1996). Many of these species may be present in Sydney Harbour. For example, a number of fish species that are typical for Nova Scotian waters, may also be found in Sydney Harbour (Vandermeulen, 1989 and Hildebrand, 1982 in Stewart, 1996). None of the marine species is fished commercially, except for lobster, but some recreational fishery can occur (Hildebrand, 1992 in Stewart, 1996). Lobster fishery traditionally occurred in both arms off the harbour, but has been closed since the early 1980s due to health concerns following the discovery of PAH in lobster tissue (Prouse, 1994 and Vandermeulen, 1989 in Stewart, 1996). However, Sydney River, Leitches Brook and Frenchvale Brook supported a viable Salmon Fishery (Hildebrand, 1982 in Stewart, 1996).

While assessments of phytoplankton and primary productivity have not been carried out (Stewart, 1996), occasional samples of zooplankton and benthic communities suggest that they are representative of Atlantic coastal species in Nova Scotia (Wendland, 1979 from Matheson et al., 1983 in Stewart, 1996; P. Lane and Associates 1988, 1989 in Stewart 1996). Interestingly, even in the most polluted areas of Sydney Harbour, a number of benthic macroinvertebrates can be found, including polychaetes (which dominate), nemerteans, and burrowing and sessile anemones.

2.1.6.5 Biological Toxicity of Sediments

Sediments collected from certain areas in Sydney Harbour are highly toxic to biota, particularly many organisms living in sediments. It has been estimated that 4 to 10 µg/g PAH in sediments can cause measurable biological effects (Chapman et al., 1987 in Lee 2002). Based on results from biotoxicity tests, sediments in most areas of the harbour are very likely harmful to benthic communities and biological productivity, especially in the South Arm. The contaminants PAH and PCB are most closely correlated with negative effects, while the confounding factor sulfide concentration also appears to be important to certain organisms. The test results also show that the contaminants in the sediment are bioavailable, and therefore can enter the food chain, with impacts on predators and human beings (Lee, 2002).

Whole sediments collected with 0.1 m^3 VanVeen samplers from the South Arm of Sydney Harbour proved acutely toxic (lethal) to marine amphipod *Amphiporeia virginiana* in 1999 and 2000, while sediments from the Northwest Arm and the remainder of the harbour were not. The toxicity was strongly correlated with the PAH (1999) and PAH and PCB (2002) levels in the sediments (Lee, 2002).

In addition, investigation of 50 Winter Flounders caught in Sydney Harbour revealed numerous histological changes and lesions in spleen, liver and gonads, even though the fish were not caught off the mouth of the tar ponds, where the contaminant concentrations are highest. The observed liver lesions are typical for chemical contamination (Lee, 2002).

The concentrations of PAH found in Sydney Harbour are potentially highly toxic and exceed the CCME Probable effects Level (PEL) for the protection of aquatic life by more than 70 times for some PAHs in nearly all areas of the harbour: almost all of the South Arm, most of the North West Arm and even parts of the Outer Harbour (Lee, 2002). The concentrations of PCBs are intermediate with regard to area and potential toxicity, exceeding the PEL (189 µg/kg, ISQL 21.5 µg/kg) by up to 40 times in the South Arm: the concentrations of PCBs are higher on the east side than the west side of the South Arm. Of the metals measured, only lead (PEL 112,000 µg/kg) and zinc (PEL 271,000 µg/kg) exceed the sediment guidelines in a limited number of locations. The exceedances are low, with 2 to 4 times the PEL limit, and are limited to the eastern side of the South Arm (Lee, 2002).

2.1.7 Wildlife and Species-at-Risk

According to most sources, no species at risk, or endangered species of plants or animals or other species of special conservation status have been regularly observed in the area. This conclusion was reached by direct observation of the site as cited in JDAC 2002 c, as well as a documentary review (Pronych and Wilson, 1993; Haber, 2000;,*CEAA*, 2000; COSEWIC, 2004; ACCDC, 2004).

However, staff at the Museum of Natural History (NSMNH, October 2004) note that bullhead catfish (*Ictalurus nebulosus*) have been associated with the Muggah Creek site. This is the only known animal species that may be of concern or note at the site. While bullhead catfish do "not have any formal status (i.e., status of concern) at this time, there are indications that the populations in the immediate area, including Sydney River and Mira River, are distinct from the rest of the Maritime Provinces" (NSMNH, 2004).

In addition, there are 2 plant species of concern known to occur at the site (NSMNH, 2004):

- *Elymus wiegandii* (Red listed), and
- *Juncus bulbosus*

Also, the following plant species of concern have been found adjacent to the site:

- *Arabis hirsuta* (Red)
- *Cyprepedium calceolus var. parviflorum* (Yellow)
- *Cyprepedium calceolus var. pubescens* (Yellow)
- *Cyprepedium reginae* (Red)
- *Isoetes prototypes* (Red)
- *Lobelia kalmii* (Yellow)
- *Megalodonta beckii* (*Bidens beckii*) (Yellow)
- *Ophioglossum pusillum* (Yellow), and
- *Vaccinium ovalifolium* (Red)

The Museum staff (2004) recommends to also consider this second list of plants, since it contains a relatively large number of species that are listed “Red” provincially.

2.1.7.1 Terrestrial Habitat and Species

Terrestrial habitats on the Coke Ovens site have been described as shrub thickets, meadows, or swales. The native species present on the site are for the most part are characteristic of disturbed early successional stages.

Bird Species

In 1997 the Canadian Wildlife Service produced a report (Technical Report Series Number 273) summarizing the volunteer surveys of waterbirds of the Sydney, Nova Scotia Area, including the Sydney Tar Ponds. Surveys were conducted at the Tar Ponds monthly, year-round from October 1993 until January 1996.

In spite of the high pollution levels and extensive urban and industrial development, the waters around Sydney supported a rich diversity and abundance of waterbirds (CWS, 1997). Throughout the course of a single study year (1993), a total of 24 species of waterbirds fed and rested at the Sydney Tar Ponds. The Tar Ponds provided overwintering habitat for American black ducks, gulls and crows and summer breeding habitat for black ducks, killdeer and song sparrows. Species diversity was greatest in the fall (15 species) when there was an influx of migrating shorebirds (CWS, 1997).

Twenty-four species of birds were identified at the Coke Ovens site (JDAC 2002c; Appendix A). The most abundant are American crows and common ravens. This area likely provides little foraging habitat as there are poor feeding opportunities for these species there. Other common species include rock doves, European starlings, house sparrows, and American robin. Suitable breeding habitat for species that use open meadows such as the killdeer and Savannah sparrow is found here. Raptors such as the red-tailed hawk and bald eagle have been reported in the watershed area.

Mammal Species

Several species of mammals were recorded (JDAC, 2002c) or are likely to be at the Coke Ovens site. They include:

- Feral and domestic cat
- Red fox
- Muskrat
- Meadow vole
- Norway rat
- River otter (1 report)
- Coyote (1 report)
- House mouse; and
- White-tailed deer.

Although not seen, it is probable that shrews (masked and short tailed) are common on the site. Muskrat and white-tailed deer are not likely to make regular use of the site, as there is a lack of forage and cover for these species.

Herpetile Species

Amphibian species associated with the Coke Ovens site include eastern American toad, green frog, and northern leopard frog (JDAC, 2002c). Two species of snake have been reported on the Coke Ovens site: maritime garter snake and eastern smooth green snake (Haber, 2000).

Mollusk Species

A total of 6 snails, 3 of which are exotics, and one European slug were documented from the Coke Ovens -Tar Ponds site (Haber, 1998; Haber, 2000). The exotic snail *Succinea putris* was found in considerable abundance throughout the complex. The snail survey and collection was incidental during the 1998 survey conducted by Haber.

2.1.7.2 Aquatic Habitat and Species

Surveys for benthic macroinvertebrates, vegetation, fish and marine species have been conducted. These surveys are discussed below.

Benthic Macroinvertebrates

A benthic macroinvertebrate (BMI) survey of the Coke Ovens Brook was undertaken during November 2001 (JDAC, 2002c). Sampling occurred on November 15 and 16, 2001. Samples were collected from 12 locations in Coke Ovens Brook as well as from 7 reference locations.

Within the Coke Ovens Brook sites, benthic communities were dominated by oligochaetes and predatory chironomid species. These forms are typically characteristic of degraded environmental conditions since they are tolerant of relatively high organic loadings (e.g., sewage inputs), and of many forms of chemical contamination.

Fish Habitat and Species

A fish habitat survey of Coke Ovens Brook was conducted in June 2001 (Foulds, 2001). The survey consisted of a walk through of the entire area of the Coke Ovens Brook watershed to determine if fish were found within the Coke Ovens Brook, MAID Pond and/or any of their tributaries. The walk through was followed by a sampling event on June 19, 2001. This survey indicated that Coke Ovens Brook is a small freshwater stream that has been altered by the extensive industrial development along its banks. The Sydney Landfill, which is located upstream from the Coke Ovens site, may also affect water and sediment quality in the reach located on the Coke Ovens site. Fish species observed include mummichog and banded killifish. Ninespine stickleback were also found in Radar Brook, a tributary to Coke Ovens Brook. The condition of the fish found varied from apparently healthy fish to fish with obvious tumours and black spot disease.

Spawning and rearing areas for mummichogs and brown bullhead may be found in the South Pond of Muggah Creek, or in MAID Pond. It is likely that ninespine stickleback probably spawn in tributaries to Coke Ovens Brook. American eel were also observed in South Pond.

Anadromous fish including salmon, trout, gaspereau, and possibly shad are found in the harbour at certain times of the year, as they are *enroute* to and from Sydney River. Migratory pelagics such as herring and mackerel occur seasonally.

2.1.7.3 Marine Species

The South Arm of Sydney Harbour was permanently closed to lobster and shellfish fishing in the 1980s due to unacceptable levels of PAHs resulting from industrial pollution. The entire Sydney Harbour area is closed to shellfish harvesting due to unacceptably high levels of faecal coliform bacteria (Environment Canada et al., 2000).

Surveys from 1978 and 1979 (Wendland, 1979 in: CWS, 1997), indicated that the benthic faunal distribution of South Arm consisted predominantly of polychaetes and sea anemones. Scuba surveys of the Northwest Arm in 1978/79 indicated that hermit crabs, limpets, and amphipods were all present in the area, but absent from the South Arm area (Wendland, 1979 in CWS, 1997).

It is likely that bottom fish species may also be found in the closure area, including flounder, cod, pollock, sculpin, wolfish, eel blenny, haddock, and others. It is unlikely that there is any sustained high abundance due to marginal habitat quality in the area.

A 1999 dive survey found a variety of macrophyte and filamentous algae and noted the presence of a number of invertebrate species including periwinkles, whelk, mussels, rock crab, toad crab, sea star and the occasional lobster and scallop.

The most common occurrences of marine mammals are seals in the springtime that migrate into the harbour to give birth to their young on the ice (Environment Canada et al., 2000). There have also been rare sightings of whales in the harbour, but it is unknown what species these were (Environment Canada et al., 2000).

2.1.7.4 Flora Species

Dr. Erich Haber of National Botanical Services in Ottawa conducted a preliminary botanical inventory and vegetation analysis of the Coke Ovens and Tar Ponds in 1998. The main purpose of that study was to focus mainly on vascular plants at the Coke Ovens site, but also to a limited extent, on the adjoining area around the Tar Ponds. In addition to vascular plants, the survey was to include an inventory of mosses and algae to the extent that time would allow. Water samples were also to be collected to assist in the interpretation of the significance of the diversity of planktonic algae present in surface waters.

The initial study identified a total of 158 vascular plants of which 13 were trees, 17 were shrub species, and 128 were herb species. The supplementary study identified another 64 species for a total of 223 species identified in the study area including: 19 tree species, 23 shrub species, 177 flowering herb species and one woody vine (Haber, 2000). The asters were most abundant followed by the grass and rose families in terms of abundance of species in the study area.

A total of 77 species that are characteristic of wet to damp habitat were recorded. This large number of wetland species found reflects the relatively high water table in the area.

Approximately 45% of species found were exotic species (non-native), including forage crops, and weed species typically associated with physically disturbed sites such as roadsides, agricultural areas, and vacant lots (Haber, 2000). This is a high proportion since it should be expected there to be about 21% exotic species in keeping with Scoggan (1978). This high proportion of exotics is most likely due to the highly disturbed nature of the site.

Of note in the survey was a prolific and lush growth of several species of forage plants and weeds that dominate sectors of the complex. The relatively speedy colonization of the area by these plants and by native shrubs is a positive indication that site remediation through soil stabilization with a vegetative cover can be achieved with a modest input to ameliorate growing conditions on a site. The main areas that remain bare of vegetation or have sparse vegetation are those where substantial coke/coal deposits are still present as deep surface layers.

There are no provincially or nationally rare vascular plants found to be present at the site (Haber, 2000).

2.1.7.5 Mosses

A total of 15 mosses were collected from the Coke Ovens-Tar Ponds site (Haber, 2000). Two species are considered rare for the Maritimes (*Bryum caespiticium* and *Campylium polygamum*). This may be a reflection of the relatively limited bryological fieldwork that has been done by the limited number of specialists in the country. The other species are considered common North American species.

2.1.8 Heritage Resources

Heritage resources within the Sydney Tar Ponds and Coke Ovens study area are briefly described in the following sections.

2.1.8.1 A Mi'kmaq Presence

It is widely known and accepted that the Mi'kmaq First Nations people were the earliest recorded inhabitants of Cape Breton. Early letters and journals of European explorers to the shores of this island since the sixteenth century make frequent reference to the aboriginal people they encountered.

The original Membertou reserve was mapped out in 1820 by Surveyor General Crawley and was located on the harbour front of King's Road where the Medical Arts Building now stands (Moore, 1994). The reserve was named in honour of Grand Chief Membertou, medicine man and Sovereign Ruler of the Mi'kmaq nation (Sydney Bicentennial Commission, 1985). A series of photographs of the Old King's Road Reserve are on file at the Beaton Institute in Sydney and show Mi'kmaq families in front of birchbark tents.

The land surrounding Sydney Harbour is reported to have been an important base for seasonal and permanent settlement by the Mi'kmaq people at least as early as the arrival of European settlers to the area in the mid-18th century. The shores of Muggah Creek and the adjacent harbour shorelines, once set further back then they are today, are believed to have been a traditional summer camp for First Nations people based on King's Road.[3] Here, on the shores of Muggah Creek, families are said to have set up birchbark conical tents, or wigwams, and fished each summer until the end of the 19th century when their land was given over freely to the Dominion Iron and Steel Company for the construction of a steel plant and coke ovens (Dimock, 1930; NSARM, 1982).

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[3] The Mi'kmaq people who lived on King's Road in the nineteenth and early twentieth centuries would later become the residents of the Membertou Reserve off present-day Alexandra Street, when they were removed from their traditional land in 1927 by a court injunction (Exchequer Court of Canada, Audette J., 16 March 1916 Indians (Ii--36)--Removal To New Reserve--Expediency Compensation) (*Ethnographies*).

Although the Mi'kmaq were removed from their summer fishing grounds in 1899, they continued to have a presence in the town of Sydney throughout the 19th and 20th centuries. Thirty years after the first post office was established in 1786, Mi'kmaq couriers from the Old King's Road reserve were employed to carry mail between Sydney and Halifax (NSARM, 1982).

2.1.8.2 Archaeological and Historical Site Significance

The original shoreline of the Tar Ponds, prior to 1900, is an area of high potential for heritage resources based on the 19th century occupation of this area by early residents of Sydney and on the potential for exploitation of marine resources by First Nations people.

The area west of the SYSCO access road is of low potential, as the land here is comprised of artificial fill, primarily slag, deposited throughout the twentieth century as a result of the steel plant's operation.

The land between Victoria Road and the SYSCO access road that houses the steel mill buildings is of low potential for heritage resources as it was leveled when the steel plant was built and, as a result, any heritage resources that were located within this area were likely destroyed at that time. However, there is a small parcel of land within this zone which has been deemed of moderate potential for heritage resources as there may exist, on the surface or just below the present buildings, remnants of the worker's camps shown (Davis Archaeological Consultants, 2004).

The land that the Coke Ovens were constructed on was also likely altered during construction and, therefore, the houses built there prior to 1900 were also destroyed. Consequently, this area has been deemed of low potential.

Those areas deemed of low potential - namely the area west of the SYSCO access road, the steel mill property itself except the area near the centre of this zone, and the Coke Ovens site – have been significantly altered by construction and operation of the steel plant and are, therefore, unlikely to contain subsurface intact heritage resources. However, as mentioned, the remains of early twentieth century workers' residences may be present on the steel plant site.

Staff of the Nova Scotia Department of Tourism, Culture and Heritage, Heritage Division, at the Nova Scotia Museum of Natural History (October 2004) confirm that the coastal portions and the lands adjacent to the steams have elevated potential for the presence of First Nations archaeological sites, even though there are no archaeological sites on record in the study area. Part of Muggah Creek has previously been assessed archaeologically.

2.2 SOCIO-ECONOMIC ENVIRONMENT

The following sections provide a general description of the socio-economic setting of the area. With the exception of Land Use and Ownership (Section 2.2.1), the description pertains to CBRM, as a whole. Land ownership is described for the lands encompassing the Tar Ponds and Coke Ovens sites.

2.2.1 Land Ownership

Land ownership of the Tar Ponds and Coke Ovens sites is shown in Figure 2.2.

The Tar Ponds are owned by Transport Canada and the NS Department of Economic Development. The area immediately surrounding the Tar Ponds consists of industrial properties and residential areas. Property adjacent to the West Shoreline includes the former Canadian National (CN) rail facilities that are presently used by CBCNS Railway. The former Sysco property is located along the East Shoreline. The Southeast Shoreline includes areas of substantial historic infilling of Muggah Creek for storage and disposal of blast furnace slag and municipal wastes. The South Pond is, essentially, a freshwater impoundment, which is generally unaffected by tides, and its salinity is characteristic of a freshwater system. In contracts the North Ponds is open to the rest of Sydney Harbour, is strongly affected by tides, and its salinity is characteristic of a estuarine system.

Most of the Coke Ovens site is owned by the Province of Nova Scotia. A strip of land owned by the CN runs through the northwest corner. Mullins Bank is owned by the CBDC. The site is bordered to the east by the MAID site, CBRM's solid waste disposal facility (the land is partially owned by the province); to the south by the former tramline land owned by the CBDC; to the west by Victoria Road and the steel mill; and to the north by the CBDC railway property. Residential, commercial and public properties in the Victoria Road, Frederick Street, Currys Lane and Vulcan Avenue areas are in close proximity. Lands southeast of the site between Oak and Elm Streets are zoned light industrial. These lands are largely privately owned and relatively undeveloped.

2.2.2 Economic Performance

2.2.2.1 Average Income

Table 2.3 shows the average income of individuals living within CBRM, Cape Breton Island counties, and Nova Scotia in 2001. The average income in both CBRM and Cape Breton County is about the same as Inverness County, and slightly more than in Richmond and Victoria Counties, but less than in all of Nova Scotia. The median family income in both CBRM and Cape Breton County is about the same as in Victoria County, slightly more than in Richmond County, and significantly less than in Inverness County. The median average income of both CBRM and Cape Breton County is $7,586 less than for Nova Scotia as a whole. The average income of males in both CBRM and Cape Breton County is approximately $6,000 less than in all of Nova Scotia, but females earn on average about $2,000 less in both CBRM and Cape Breton County than do females in all of Nova Scotia.

TABLE 2.3 Average Income in CBRM, Cape Breton Island Counties and Nova Scotia in 2001

	CBRM	Cape Breton County	Inverness County	Richmond County	Victoria County	Nova Scotia
Male	$26,688	$26,422	$27,913	$26,656	$23,913	$32,328
Female	$18,398	$18,296	$16,004	$15,644	$15,562	$20,338
Average	$22,602	$22,416	$22,379	$21,663	$19,976	$26,632
Medium Family Income	$38,937	$38,228	$45,207	$37,159	$38,718	$46,523

Source: Statistics Canada

Table 2.4 and 2.5 show the percentage and numbers of labour force activity by occupational category of CBRM, Cape Breton Island counties and Nova Scotia for the years 1986-2001.

Cape Breton County is percentage-wise less than Nova Scotia for most categories except sales and services and trade and transport, as well as health and social sciences and education and government. Table 2.5 shows that in most categories, the actual number of employed people has decreased since 1996 in Cape Breton County.

TABLE 2.4 Percentage of Labour Force Activity by Occupational Category in CBRM, Cape Breton Island Counties and Nova Scotia, 1986-2001

Category	Year	CBRM	Cape Breton County	Inverness County	Richmond County	Victoria County	Nova Scotia
1996-2001							
Management	2001	6.9	7	7	6.7	7.8	9.6
	1996	-	5.7	7.5	4.5	7.7	8.4
Business, Finance, Admin	2001	14.6	14.6	11.2	10.4	10.5	16.0
	1996	--	14.0	12.6	12.1	8.8	16.6
Natural and Applied Sciences	2001	3.1	3.1	3.2	4.7	3.1	5.1
	1996	-	2.3	2.7	2.1	1.6	3.9
Health	2001	8.5	8.4	5.7	5.4	5	6.1
	1996	-	7.2	4.1	4.6	6.2	5.8
Social Science, Education, Government	2001	8.6	8.8	6.4	6.8	7.4	7.5
	1996	-	8.0	6.4	7.5	4.7	6.7
Art, Culture, Recreation, Sport	2001	1.9	1.9	2.4	2.2	4.1	2.5
	1996	-	2.1	1.9	1.7	2.4	2.4
Sales and Service	2001	32.1	32	28	2.4	22.4	27.2
	1996	-	32.4	26.7	26.0	31.2	28.8
Trades, Transport, Equipment Op.	2001	16.7	16.7	19	21.8	14.1	14.9
	1996	-	17.7	17.5	25.0	16.1	14.9
Primary Industry	2001	4.3	4.4	11	7.4	21.2	5.6
	1996	-	6.5	13.8	7.3	17.7	6.5
Processing, Manufacturing, Utilities	2001	3.3	3.3	6.3	10.2	4.6	5.5
	1996	-	4.2	6.7	9.1	3.5	6.1
Total	2001	41,695	42,630	9,100	4,170	3,575	442,420
	1996	-	424,820	9,225	4,335	44,335	3,700
1986-1991							
Managerial, administrative & related	1991	-	7.3	7.6	7.2	6.1	9.7
	1986	-	7.0	7.0	6.3	6.6	8.6
Teaching & related	1991	-	5.4	4.8	5.0	4.6	6.7
	1986	-	5.2	4.7	4.1	5.0	4.6
Medicine & health	1991	-	5.2	5.4	5.9	3.7	4.6
	1986	-	6.3	4.3	4.2	4.6	5.4
Technology, social, religious, artistic & related	1991	-	7.1	5.5	3.9	5.2	6.0
	1986	-	4.9	4.7	3.9	3.4	5.9
Clerical & related	1991	-	15.9	13.2	11.0	10.8	16.7
	1986	-	15.2	13.0	10.8	10.2	16.5
Sales	1991	-	9.7	7.2	5.7	5.5	9.0
	1986	-	9.3	7.0	6.3	4.3	8.7
Service	1991	-	15.5	15.3	14.7	20.2	15.3
	1986	-	14.1	14.4	14.1	19.3	15.7
Primary occupations	1991	-	6.8	13.7	9.5	18.5	6.1
	1986	-	7.4	15.2	11.5	20.9	6.8
Processing	1991	-	4.0	6.2	9.7	4.6	3.9
	1986	-	5.3	5.6	8.0	3.3	4.4
Machining, product fabrication, assembling & repairing	1991	-	5.9	5.3	6.8	4.3	6.8
	1986	-	6.3	5.2	6.6	3.8	7.1
Construction trades	1991	-	7.9	8.1	8.5	8.2	6.8
	1986	-	8.8	8.6	12.2	7.5	7.6
Transport equipment operating	1991	-	4.0	3.1	5.9	4.9	3.9
	1986	-	4.4	4.2	5.8	5.4	4.1
Other	1991	-	5.2	4.7	5.8	3.1	4.4
	1986	-	5.9	6.0	6.4	5.6	4.7
Total	1991	-	47,985	9,845	4,580	4,155	439,840
	1986	-	48,315	9,615	4,385	3,990	406,205

Source: Statistics Canada

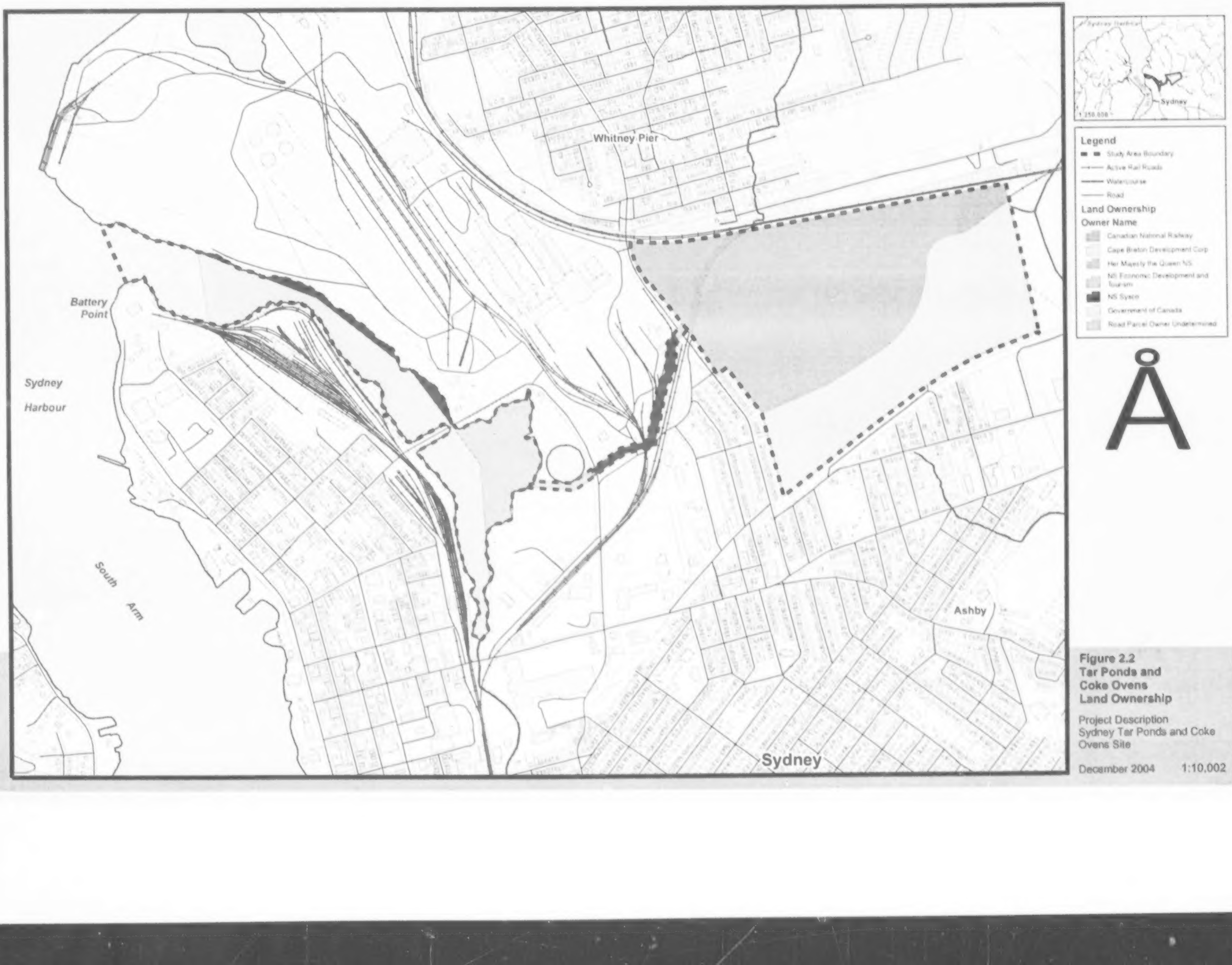
Sydney Harbour
Sydney
1:250,000
Legend
Study Area Boundary
Active Rail Roads
Watercourse
Road
Land Ownership
Owner Name
Canadian National Railway
Cape Breton Development Corp
Her Majesty the Queen NS
NS Economic Development and Tourism
NS Sysco
Government of Canada
Road Parcel Owner Undetermined
Whitney Pier
Battery Point
Sydney Harbour
South Arm
Ashby
Sydney

Figure 2.2
Tar Ponds and
Coke Ovens
Land Ownership

Project Description
Sydney Tar Ponds and Coke Ovens Site

December 2004 1:10,002

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TABLE 2.5 **Number of Labour Force Activity by Occupational Category in CBRM, Cape Breton Island Counties and Nova Scotia, 1986-2001**

Category	Year	CBRM	Cape Breton County	Inverness County	Richmond County	Victoria County	Nova Scotia
1996-2001							
Management	2001	2,895	2,515	695	195	280	35,485
	1996	-	2,960	635	280	285	42,305
Business, Finance, Admin	2001	6,095	6,215	1,165	525	375	70,415
	1996	-	6.200	1,010	440	325	70,735
Natural and Applied Sciences	2001	1,290	1,005	245	90	110	16,460
	1996	--	1,320	290	195	60	22,580
Health	2001	3,545	3,185	380	200	180	24,570
	1996	-	3,555	515	225	230	26,850
Social Science, Education, Government	2001	3,590	3,565	595	325	260	28,485
	1996	-	3,745	585	280	175	33,375
Art, Culture, Recreation, Sport	2001	790	920	175	75	145	10,345
	1996	-	820	215	90	90	11,125
Sales and Service	2001	13,370	14,365	2,460	1,125	800	122,195
	1996	-	13,640	2,545	1,015	1,155	120,290
Trades, Transport, Equipment Op.	2001	6,960	7,830	1,610	1,085	505	63,155
	1996	-	7,130	1,720	915	595	66,095
Primary Industry	2001	1,790	2,885	1,275	315	760	27,700
	1996	-	1,850	1,010	310	655	24,825
Processing, Manufacturing, Utilities	2001	1,385	1,855	620	395	160	26,005
	1996	-	1,395	570	425	130	24,245
Total	2001	41,695	44,335	9,225	4,335	3,580	424,820
	1996	-	42,625	9,100	4,175	3,700	442,425
1986-1991							
Managerial, administrative & related	1991	-	3,500	745	330	255	42,650
	1986	-	3,395	675	275	265	34,810
Teaching & related	1991	-	2,495	530	270	155	20,390
	1986	-	2,505	450	180	200	18,675
Medicine & health	1991	-	3,405	540	180	215	26,325
	1986	-	3,040	415	185	185	22,100
Technology, social, religious, artistic & related	1991	-	2,580	470	230	190	29,645
	1986	-	2,375	450	170	135	24,065
Clerical & related	1991	-	7,645	1,295	505	450	73,505
	1986	-	7,350	1,250	475	405	66,825
Sales	1991	-	4,650	710	260	230	39,745
	1986	-	4,470	675	275	170	35,350
Service	1991	-	7,455	1,505	675	840	67,140
	1986	-	6,820	1,380	620	770	63,650
Primary occupations	1991	-	3,270	1,345	435	770	26,880
	1986	-	3,555	1,465	505	835	27,630
Processing	1991	-	1,935	615	445	190	17,105
	1986	-	2,555	535	350	130	17,895
Machining, product fabrication, assembling & repairing	1991	-	2,815	520	310	180	29,880
	1986	-	3,040	500	290	150	28,810
Construction trades	1991	-	3,800	800	390	340	29,970
	1986	-	4,230	825	535	300	30,690
Transport equipment operating	1991	-	1,930	310	270	205	17,340
	1986	-	2,130	400	255	215	16,580
Other	1991	-	2,475	460	265	130	19,230
	1986	-	2,850	580	280	225	19,115
Total	1991	-	47,985	9,845	4,580	4,155	439,840
	1986	-	**48,315**	**9,615**	**4,385**	**3,990**	**406,205**

Source: Statistics Canada

Table 2.6 shows that the major employers in Cape Breton Island are located in Sydney (11), North Sydney (4), New Waterford (3), Glace Bay (3), and Louisbourg (1). More than half of them are government related. At least 7 of the major employers are health related.

TABLE 2.6 Major Employers, CBRM, 2002

Major Employer	Location
Breton Bay Nursing Home	Sydney
Breton Education Centre	New Waterford
Cape Breton Healthcare Complex	Sydney
Cape Breton Post	Sydney
CBCNS Railway	Sydney
CBRM	Sydney
Cape Breton-Victoria Regional School Board	Sydney
Casinos Nova Scotia	Sydney
Copol International Ltd. Packaging Films	North Sydney
EDS Canada	Sydney
Fortress of Louisbourg	Louisbourg
Glace Bay Fisheries	Glace Bay
Glace Bay Healthcare Corp.	Glace Bay
ICT Group	Sydney
Marine Atlantic	North Sydney
New Waterford Consolidated Hospital	New Waterford
New Waterford Homemaker Service Society	New Waterford
Northside Community Guest Home	North Sydney
Northside General & Harbour view Hospitals	North Sydney
Ron Webber & Associates	Sydney
Stream International Inc.	Glace Bay
University College of Cape Breton	Sydney

Source: Nova Scotia Department of Finance, Statistics Division

2.2.2.2 Unemployment

Table 2.7 shows the unemployment rate in CBRM, Cape Breton Island counties, and Nova Scotia as a whole in 2001. The unemployment rates in both CBRM and Cape Breton County are below the other 3 counties on Cape Breton island, but 8.5% above all of Nova Scotia. The male unemployment rate in both CBRM and Cape Breton County is higher than in Inverness County, but below Richmond and Victoria County. It also is almost 12% higher than all of Nova Scotia's male unemployment rate. The female unemployment rate in both CBRM and Cape Breton Country is lower than in the other 3 counties, but 5.1% higher than all of Nova Scotia's female unemployment rate.

TABLE 2.7 Unemployment Rate in CBRM, Cape Breton Island Counties and Nova Scotia in 2001

	CBRM	Cape Breton County	Inverness County	Richmond County	Victoria County	Nova Scotia
Male	23.2	23.5	20.1	28.7	34.6	11.3
Female	15.5	15.7	20	22.1	33.4	10.4
Total	19.4	19.7	20.1	25.6	34.2	10.9

Source: Statistics Canada

2.2.3 Primary Industries

2.2.3.1 Agriculture

According to Nova Scotia Business Statistics, in 2002 there were 33 agriculture related businesses in Cape Breton County, which is 4 less than in Inverness County and 27 more than in Richmond County, and 22 more than in Victoria County. Agriculture provides disproportionately less on a percentage basis to the CBRM economy than does CBRM's population to the rest of Nova Scotia. It is home to 3.5% of the total number of farm operations in the province and provides only slightly more than 2% of the total provincial gross farm receipts, yet CBRM comprises approximately 13% of the total provincial population.

The primary products produced in CBRM are: fruits, vegetables, berries, dairy and meat. Eggs and berries are exported. The farms range from organic to hydroponics green house to large-scale land intensive livestock operations. Several of these farms are considered large by Nova Scotia standards, but not of the "factory" farm type. Direct employment is estimated at several hundred. The major agricultural area is Boularderie Island, particularly near Millville. Livestock operations are combined with large scale grazing area and large scale feed cultivation areas (CBRM, 2004).

2.2.3.2 Forestry

The forest industry consists of 3 sub-sectors: cultivation and harvesting, silviculture and reforestation, and milling and processing. According to Nova Scotia Business Statistics, in 2002, there were 26 forest related businesses in Cape Breton County, which is 4 less than in Inverness County, 16 more than in Richmond County, and 17 more than in Victoria County.

The forestry industry in CBRM has been depleted due to over harvesting and the spruce budworm infestation in the 1970s that caused much of the forest to be stunted and diseased. Unless the present crop is harvested, new trees of higher value will be unable to grow. A large amount of privately owned forest remains unharvested because little incentive exists to replace it.

The forest labour force is very small due to the small size of forestry operations as well as the increased mechanization of the industry (e.g., mechanical harvesters) (CBRM, 2004).

2.2.3.3 Fishery

The fishery consists of 3 sub-sectors: harvesting, processing and marketing. According to Nova Scotia Business Statistics, in 2002 there were 235 fishing and trapping related businesses in Cape Breton County, which is 57 more than in Inverness County, 198 more than in Richmond County, and 65 more than in Victoria County. The CBRM fishery in 2003 was worth approximately $50 million which is about two-thirds less than its worth in the 1980s (approximately $150 million) as a result of the groundfish moratorium imposed by the Federal Department of Fisheries and Oceans (DFO) in 1992. The moratorium is still in effect with no indication that the groundfish stocks have recovered sufficiently for it to be lifted and with little scientific knowledge of all the reasons for its decline.

The Gulf fishery, which is still a major fishery for many species, encompasses the west coast of Cape Breton, which is a considerable distance from the Study Area, and is fished by all 3 Atlantic Provinces. The only notable fisheries located on the east coast of Cape Breton Island are the lobster and rock crab fisheries located in Zone 27.

Since the groundfish moratorium, the fishery of CBRM and Cape Breton County has diversified to include:

- Increased catches of snow crab, shrimp, lobster, clam and herring;
- Harvesting of previously underutilized species such as rock crab and sea urchin; and
- The establishment of an aquaculture sector (CBRM, 2004).

The fishery is currently the largest employer outside of the 3 levels of government (Ibid). Fish plants are located throughout Cape Breton County.

2.2.3.4 Mining

According to the Nova Scotia Business Statistics, in 2002 there were 10 mines or quarry sites in Cape Breton County, which is 7 more than in Inverness County, and 8 more than in Victoria County. Richmond County has no sites. CBRM and Cape Breton County were known for their abundance of coal that still exists today, but the industry declined as a result of a combination of factors including:

- The cost of extraction
- Its low grade (e.g., high sulphur content)
- Increasingly strict and costly environmental regulations; and
- The rise of low cost alternatives.

According to the Nova Scotia Department of Natural Resources, approximately 10 million tons of coal reserves exist that can be extracted using surface-mining techniques. It has been suggested that if demand exists for this coal, it would be mined using private rather than the previous public resources. As a power source, coal could be developed in the future by a company such as Nova Scotia Power Inc. (CBRM, 2004).

Other mining in CBRM and Cape Breton County includes the extraction of gravel and sand for the construction and repair of streets, roads, highways and driveways, using an open pit method because of its superficial nature.

2.2.4 Secondary Industries

2.2.4.1 Manufacturing

According to Nova Scotia Business Statistics, in 2002, there were 116 manufacturing businesses in Cape Breton County, which is 77 more than in Inverness County, 100 more than in Richmond County, and 74 more than in Victoria County. In 2002, the largest number of manufacturers is found in the food manufacturing sector, both in Nova Scotia as a whole and Cape Breton County. The largest number of employees per sector is also found in the food manufacturing sector for all of Nova Scotia, while in Cape Breton County, the largest number is found in primary metal manufacturing, while the food manufacturing sector comes in second.

2.2.4.2 Construction

According to Nova Scotia Business Statistics, in 2002 there were 337 construction firms in Cape Breton County, which is 243 more than in Inverness County, 298 more than in Richmond County, and 302 more than in Victoria County. Table 2.8 shows the value of building permits for CBRM, Cape Breton Island Counties and Nova Scotia.

TABLE 2.8 **Value of Building Permits by Sector for CBRM, Cape Breton Island Counties and Nova Scotia in 2002**

	Residential ($'000)	Industrial ($'000)	Commercial ($'000)	Institutional & Government ($'000)	Total ($'000)
Nova Scotia	623,911	51,140	167,768	31,481	877,300
CBRM (Region 21)	42,228	12,528	25,778	5,764	86,298
Cape Breton County	20,744	7,264	22,717	5,117	55,842
Inverness County	8,523	1,237	1,444	341	11,545
Richmond County	5,501	2,096	685	15	8,297
Victoria County	7,460	1,931	932	291	10,614

Source: Statistics Canada, Investment and Capital Stock Division, Special Tabulation Table 32.2

2.3 REGULATORY ENVIRONMENT

For some of the elements of the remediation project there is a clear understanding of the governing jurisdiction. There are, however, aspects of the project that could fall within the environmental regulatory jurisdictions of either, or both, the Federal and Provincial governments; there are also some aspects of the project that would be subject to the requirements of municipal bylaws.

In summary, it is understood that contaminated materials that will be removed from their current location, and/or derived as a result of the application of remediation technologies, will be required to meet existing and applicable environmental regulatory standards.

The following sections present a summary of the requirements of the most pertinent federal, provincial and municipal legislation that are appropriate to existing conditions and/or proposed actions at the Tar Ponds and Coke Ovens sites.

2.3.1 Federal Environmental Legislation

The primary federal environmental management legislation that is appropriate to the planning and implementation of the remediation project includes, but is not necessarily limited to, the following:

- *Canadian Environmental Assessment Act* (CEAA);
- *Fisheries Act*;
- *Navigable Waters Protection Act* (NWPA);
- *Canadian Environmental Protection Act* (CEPA); and
- *Transportation of Dangerous Goods Act.*

A list of the applicable federal legislation is identified in Tables 2.9 and 2.10 for the Tar Ponds and Coke Ovens sites, respectively (from CBCL/ENSR, 2003a, 2003b).

TABLE 2.9 Applicable Federal Environmental Legislation – Tar Ponds Site

Legislation	Reference	Potential Related Activity Tar Ponds Remediation	Government Department or Agency	Requirement	Canadian Environmental Assessment Act
Fisheries Act	Section 32: Destruction of Fish Section 35: Harmful Alteration, Disruption, Destruction of Fish Habitat (HADD)	Alterations to surface streams, wetlands, etc. Dredging sediments Sub aqueous capping of sediments Infilling areas of the tar ponds and estuary Disposal at sea Construction of cofferdams in the estuary Alterations to Tar Ponds shorelines Alterations to surface streams, wetlands, etc. Blasting	Fisheries and Oceans Canada: Habitat Management	Ministerial Authorization	CEAA Trigger Responsible Authority
Fisheries Act	Section 36: Deleterious Substances	De-watering sediments Leachate/spills from on-site storage areas (waste materials, chemicals) Sanitary wastes from construction camps Wastewater discharges	Environment Canada: Environmental Protection Service	Compliance	No CEAA Trigger
Navigable Waters Protection Act (NWPA)	Regulations	Alteration to surface streams, wetlands as a result of rerouting, culvert installation etc. Dredging sediments Sub aqueous capping of sediments Infilling areas of the tar ponds and estuary Construction of coffer dams in the estuary	Transport Canada	HADD Assessment Compliance Permit	CEAA Trigger Responsible Authority

TABLE 2.9 Applicable Federal Environmental Legislation – Tar Ponds Site

Legislation	Reference	Potential Related Activity Tar Ponds Remediation	Government Department or Agency	Requirement	Canadian Environmental Assessment Act
Canadian Environmental Protection Act (CEPA)	Disposal at Sea Regulations Application for Disposal at Sea Regulations	Movement /replacing/ sidecasting of sediments in the North Tar Pond Disposal of sediments (contained or not) in the ocean Redeposition of treated sediments in the North Tar Pond Placement of cover material	Environment Canada: Environmental Protection Service (EPS)	Permit	CEAA Trigger
CEPA	Federal Mobile PCB Treatment and Destruction Regulations	Operation or testing of a mobile PCB treatment or destruction system	Environment Canada: (EPS)	Ministerial Authorization	CEAA Trigger
CEPA	Interprovincial Movement of Hazardous Waste Regulations	Transport of hazardous wastes across provincial boundaries	Environment Canada: (EPS)	Compliance	
CEPA	Storage of PCB Materials Regulations	Collection and storage, transportation, treatment and disposal of PCB-containing contaminated materials	Environment Canada: (EPS)	Compliance	
CEPA	Chlorobiphenyls Regulations	Release of PCB materials (>50 mg/kg)	Environment Canada: (EPS)	Compliance	
CEPA	Federal Petroleum Storage Tank Regulations	Storage and handling of fuels during site remediation	Environment Canada: (EPS)	Compliance	
CEPA	New substances Notification Regulations	Import of chemicals or biotechnology new to Canada for use on site in bioremediation and/or treatment processes	Environment Canada	Notification	
Transportation of Dangerous Goods Act	Regulations	Movement of chemicals to the site for treatment processes, movement of contaminated waste materials from the site to off-site treatment/disposal facilities.	Transport Canada	Compliance	
Canada Shipping Act	Air Pollution Regulations Oil Pollution Prevention Regulations Pollutant Discharge Reporting Regulations Pollutant Substances Regulations	All activities related to the safe and efficient operation of vessels carrying contaminated materials, fuels, or other pollutant substances	Transport Canada	Compliance	

TABLE 2.9 Applicable Federal Environmental Legislation – Tar Ponds Site

Legislation	Reference	Potential Related Activity Tar Ponds Remediation	Government Department or Agency	Requirement	Canadian Environmental Assessment Act
Canada Shipping Act	Aids to Navigation Protection Regulations	Any activities that affect existing navigational aids	Transport Canada	Compliance	
Canada Shipping Act	Dangerous Bulk Materials Regulations Dangerous Chemicals and Noxious Liquid Substances Regulations Dangerous Goods Shipping Regs	Shipment of contaminated materials In water construction operations	Port Authority and Harbour Master	Compliance Documentation Reporting Approval	
Canada Labour Code	Marine Occupational and Health Regulations On Board Trains Occupational Safety and Health Regulations	Operation of vessels Transportation of materials/waste by ship Inter-provincial rail transportation		Compliance Documentation Reporting	
Migratory Birds Convention Act	Regulations Section 6 Regulations Section 35	Physical disturbance (feeding, breeding, movement, staging areas), destruction, or possession of a migratory bird or a nest or egg Noise Deposition of oil, oil wastes, or other harmful substances on migratory birds, in water, or on land frequented by migratory birds	Environment Canada: Canadian Wildlife Service (CWS)	Compliance	
Species at Risk Act		Alteration or disruption of wildlife habitat noise, dust, air pollutants	Environment Canada: CWS	Compliance	
Federal Real Property Act	Federal Real Property Regulations	Physical activities that use or occupy Federal lands (or use or occupy the seabed within the boundaries of Sydney Harbour)	Transport Canada	License	CEAA Trigger
Canadian Environmental Assessment Act	Section 5	Any aspect of project implementation that uses Federal funds Defined federal authorizations Use of federal land	Canadian Environmental Assessment Office	Release from Act	

TABLE 2.10 Applicable Federal Environmental Legislation – Coke Ovens Site

Legislation	Reference	Potential Related Activity Coke Ovens Remediation	Government Department or Agency	Requirement	Canadian Environmental Assessment Act
Fisheries Act	Section 32: Destruction of Fish Section 35: Harmful Alteration, Disruption, Destruction of Fish Habitat (HADD)	Alterations to surface streams, wetlands, etc. Alterations to surface streams, wetlands, etc. Blasting	Fisheries and Oceans Canada: Habitat Management	Ministerial Authorization	CEAA Trigger Responsible Authority
Fisheries Act	Section 36: Deleterious Substances	Leachate/spills from on-site storage areas (waste materials, chemicals) Sanitary wastes from construction camps Wastewater discharges	Environment Canada: Environmental Protection Service	Compliance	No CEAA Trigger
Navigable Waters Protection Act (NWPA)	Regulations	Alteration to surface streams, wetlands as a result of rerouting, culvert installation etc.	Transport Canada	HADD Assessment Compliance Permit	CEAA Trigger Responsible Authority
CEPA	Interprovincial Movement of Hazardous Waste Regulations	Transport of hazardous wastes across provincial boundaries	Environment Canada: (EPS)	Compliance	
CEPA	Federal Petroleum Storage Tank Regulations	Storage and handling of fuels during site remediation	Environment Canada: (EPS)	Compliance	
CEPA	New Substances Notification Regulations	Import of chemicals or biotechnology new to Canada for use on site in bioremediation and/or treatment processes	Environment Canada	Notification	
Transportation of Dangerous Goods Act	Regulations	Movement of chemicals to the site for treatment processes, movement of contaminated waste materials from the site to off-site treatment/disposal facilities.	Transport Canada	Compliance	
Canada Shipping Act	Dangerous Bulk Materials Regulations Dangerous Chemicals and Noxious Liquid Substances Regulations Dangerous Goods Shipping Regs On Board Trains	Shipment of contaminated materials In water construction operations	Port Authority and Harbour Master	Compliance Documentation Reporting Approval Compliance	

TABLE 2.10 Applicable Federal Environmental Legislation – Coke Ovens Site

Legislation	Reference	Potential Related Activity Coke Ovens Remediation	Government Department or Agency	Requirement	Canadian Environmental Assessment Act
Canada Labour Code	Occupational Safety and Health Regulations	Inter-provincial rail transportation		Documentation Reporting	
Migratory Birds Convention Act	Regulations Section 6 Regulations Section 35	Physical disturbance (feeding, breeding, movement, staging areas), destruction, or possession of a migratory bird or a nest or egg Noise Deposition of oil, oil wastes, or other harmful substances on migratory birds, in water, or on land frequented by migratory birds	Environment Canada: Canadian Wildlife Service (CWS)	Compliance	
Species at Risk Act		Alteration or disruption of wildlife habitat Noise, dust, air pollutants Physical activities that use or occupy	Environment Canada: CWS	Compliance	
Federal Real Property Act	Federal Real Property Regulations	Federal lands (or use or occupy the seabed within the boundaries of Sydney Harbour)	Transport Canada	License	CEAA Trigger
Canadian Environmental Assessment Act	Section 5(1)	Any aspect of project implementation that uses Federal funds Defined federal authorizations Use of federal land	Canadian Environmental Assessment Office	Release from Act	

2.3.1.1 Canadian Environmental Assessment Act (CEAA)

It is likely that the remediation project will be subject to the requirements of *CEAA*. In accordance with Section 5(1) of *CEAA* federal departments and agencies must undertake an environmental assessment before:

- They carry out a project;
- Provide financial assistance to enable a project to be carried out;
- Sell, lease or otherwise transfer control or administration of land to enable a project to be undertaken; or
- Issue an authorization to enable a project to go forward.

The scope of the assessment that will be required has not been determined and will be dependent on the identification of potential project-environment interactions. It is stressed that the intent of the remediation project is to redress past environmental damage at both the Tar Ponds and Coke Ovens sites and to execute all remediation work in accordance with all pertinent regulations, and with the Community Evaluation Criteria.

2.3.1.2 Fisheries Act

In Canada, the primary federal legislative tool to protect freshwater and marine species and habitat is the *Fisheries Act*. Protection of fish and fish habitat are primarily provided for by Sections 32, 35, and 36 of the Act.

Section 32 states that no person shall destroy fish by any means other that fishing, except as authorized by the Minister, or other regulations under the *Fisheries Act*.

Section 35 states that no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat, except as authorized by the Minister or under regulations promulgated under the Act.

Section 36 prohibits the deposit of deleterious substances in waters frequented by fish.

Although responsibility for the administration and enforcement of the *Fisheries Act* largely falls to Fisheries and Oceans Canada, Section 36 (Deleterious Substances) is enforced by Environment Canada.

The *Fisheries Act* defines fish as "parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals; and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals".

The Act defines fish habitat as "spawning grounds, and nursery, rearing, food supply, and migration areas on which fish depend directly, or indirectly in order to carry out their life processes".

The following sections provide further detail with respect to sections 35 and 36 of the Act.

Section 35: Harmful Alteration, Disruption or Destruction of Fish Habitat

In recent years, the Department of Fisheries and Oceans has required, prior to construction, a Ministerial Authorization for the Harmful Alteration, Disruption or Destruction of Fish Habitat (HADD) for all activities that have the potential to damage fish and/or fish habitat. The issuance of an HADD Ministerial Authorization is a trigger for the *CEAA*.

Potential activities associated with the proposed remediation project that may fall under the provisions of the *Fisheries Act* include, but may not be limited to, the following:

- physical alterations to fish habitat in watercourses, including the relocation of watercourses and the construction of cofferdams to allow work to take place in a dry environment;
- removal of soils and/or sediments from site watercourses and or the Tar Ponds;
- subaqueous capping of sediments;
- filling in of areas of the South or North Ponds;

- placement of soils and /or sediments in the South or North Ponds;
- construction of cofferdams in the estuary;
- blasting; and
- additional invasive sampling programs, if required.

The terms and conditions that would govern these activities are often specific to the individual HADD Ministerial Authorization sought for a project, and based on existing regulations, standards, guidelines and codes of practice.

Section 36: Deleterious Substances

Deposition of a deleterious substance in waters that are frequented by fish, or in any area where the substance could enter waters frequented by fish, is prohibited under Section 36 of the *Fisheries Act*, except where the activity has been authorized by regulations.

Enforcement of Section 36 is the primary responsibility of Environment Canada and is administered through the Environmental Protection Service.

A deleterious substance is defined by the Act to be:

- "any substance that, if added to water, would degrade or alter, or form part of a process of degradation or alteration, of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat, or to the use by man of fish that frequent that water, or
- any water that contains a substance in such quantity or concentration or that has been so treated, processed or changed, by heat or other means, from a natural state, that it would, if added to any other water, degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use of by man of fish that frequent that water".

A deposit is defined by the Act to be: "any discharging, spraying, releasing, spilling, leaking, seeping, pouring, emitting, emptying, throwing, dumping, or placing".

There are no regulations or prescriptive guidelines under the *Fisheries Act* that define standards for water quality specific to the cleanup of contaminated sites in Canada. The Act does have regulations that define effluent quality standards for selected industries (e.g., *Pulp and Paper Effluent Regulations*). These standards are not appropriate for direct application to wastewater quality objectives for the Tar Ponds and Coke Ovens remediation project. In the absence of regulated water quality standards, regulatory agencies such as Fisheries and Oceans and Environment Canada can and do rely on site specific acute lethality tests, and may reference water quality guidelines developed by the CCME (2001).

As Section 36 is primarily administered as punitive legislation, there are no approvals, permits or authorizations required from the Department. Neither is there a trigger for the *CEAA*. However, it is often the case that projects on or near water will require a Ministerial Authorization (Fisheries and Oceans) based on Sections 32 and 35 of the Act. The subsequent triggering of the *CEAA* will require coordination with other Federal Departments that may have a related jurisdiction for the project. Any Federal department that considers itself to have a jurisdictional decision related to the project, or can offer specific advice on aspects of the project, can name itself as an Expert in the *CEAA* process, and have its concerns addressed as the project assessment moves forward. Environment Canada, in cooperation with Fisheries and Oceans would most likely be considered the Expert on matters of deleterious substances, and, together with the provisions of Section 37 of the Act could use the *CEAA* process to ensure that appropriate standards for water quality are established and met by the project.

Potential activities associated with the proposed remediation project that may fall under this legislation include, but may not be limited to, the following:

- removal of sediments from the Coke Ovens Brook or the Tar Ponds;
- dewatering of sediments;
- sub-aqueous capping of sediments;
- infilling areas of the Ponds;
- construction of coffer dams in the estuary;
- alterations to tar ponds shorelines;
- leachate/spills from on-site storage areas (waste materials, chemicals);
- sanitary wastes from construction camps; and
- treated and untreated wastewater discharges.

2.3.1.3 Navigable Waters Protection Act (NWPA)

The *Navigable Waters Protection Act* is Federal legislation administered by Transport Canada.

Navigable waters are defined by the Act to include a canal and any other body of water created or altered as a result of the construction of any work. Transport Canada retains the responsibility of determining whether a watercourse is navigable. As yet, the *NWPA* status of the North and South Ponds, and Wash and Coke Ovens Brook has not been determined.

The *NWPA* defines a work covered by the Act to include:

- any bridge, boom, dam, wharf, dock, pier, tunnel or pipe and the associated approaches or other works;
- any dumping of fill or excavation of materials from the bed of a navigable water;
- any telegraph or power cable or wire; or
- any structure, device or thing, whether similar in character to anything referred to in this definition or not, that may interfere with navigation.

Any such work that the Minister considers to substantially interfere with navigation requires an approval from the Minister. The issuance of an *NWPA* approval is a trigger for the *Canadian Environmental Protection Act*.

Remediation project activities that could require permitting under the *NWPA* could include:

- physical changes to site watercourses through relocation, alterations to channel depth and/or configuration, culvert placement, bridging, etc.;

- removal and/or replacement of sediment and shoreline soils in the North and South Ponds;
- sub-aqueous capping of sediment in the North and South Ponds;
- any form of infilling of North and South Ponds;
- placement of temporary anchoring and containment measures including containment curtains, sheetpiling, etc.;
- reconstruction of the shorelines of the Ponds; and
- construction of shoreline walkways, look-offs, docks, etc.

2.3.1.4 Canadian Environmental Protection Act (CEPA)

The *Canadian Environmental Protection Act* (CEPA) is Federal legislation administered by Environment Canada. The Act has a number of associated regulations that have potential for application to the remediation of the Tar Ponds and Coke Ovens sites. These regulations are discussed in brief in the following sections.

Disposal at Sea Regulations

The *CEPA* prohibits the disposal at sea of any substance, except in accordance with a permit. The Act functionally defines the landward limits of the sea to include harbours and bays up to the high water mark. Currently the North Pond, but not South Pond, is considered to be part of the sea. Issuance of a Disposal at Sea permit is a trigger for the *CEAA*.

The *CEPA* restricts disposal at sea to 6 substances, one of which is dredged material from any source. Prior to disposal all contaminants within such dredged materials must meet the following screening limits (lower action levels):

Mercury	0.75 mg/kg
Cadmium	0.60 mg/kg
Total PAHs	2.5 mg/kg
Total PCBs	0.10 mg/kg

Dredged materials that fail to meet these standards may be subjected to a range of bioassays that include an acute lethality test using a marine amphipod and 2 of the following tests:

- the sub-lethal bacterial luminescence of Microtox test;
- the sub-lethal echinoid fertilization test; or
- an EPA sediment bioaccumulation test.

The current Users Guide to the Application Form for Ocean Disposal (EC, 1995) states that if the substance proposed for disposal at sea contains substances that exceed regulated or guideline concentrations, and either fails the acute test, or 2 or more of the additional tests (including sublethal and bioaccumulation tests), this material will not be permitted for disposal at sea. The material may be treated to reduce contamination and then retested for disposal at sea.

The guide also states that, in limited cases, contaminated dredged materials may be addressed using disposal management techniques in which the COCs contained within the material have been reduced or controlled to a level that does not constitute a hazard to human health, harm to living resources, damage to amenities or interference with legitimate uses of the sea.

As the federal government of Canada considers the North Pond to be the "sea", remediation activities that may require a Disposal at Sea permit may include one or more of the following:

- displacement of contaminated sediments to other areas of the North Pond, as a direct or indirect consequence of such activities as the construction of cofferdams and/or construction access, the diversion of watercourses, the stabilization of shorelines, the construction of new outfalls and/or the lengthening or displacement of existing outfalls;
- *in situ* capping of contaminated sediments in the North Ponds; and/or
- placement of subaqueous caps on the floor of the North Pond.

Federal Mobile PCB Treatment and Destruction Regulations

The *CEPA* Regulations define PCB materials in following terms:

- PCB Liquid is a liquid that contains more than 50 mg/L of PCBs;
- PCB Solid is a solid that contains more than 50 mg/kg of PCBs; and
- PCB Substance is a substance, other than a PCB Liquid, or a PCB Solid, that contains more than 50 mg/kg of PCBs.

CEPA regulations also govern mobile PCB destruction systems (thermal treatment) and mobile PCB treatment systems (chemical treatment) that are operated on federal land or aboriginal land, or anywhere in Canada by, or under contract with, a federal institution. Operation of such a facility requires a Ministerial Authorization, the issuance of which is a *CEAA* trigger.

The Regulations require that all gas emissions to the environment from these treatment technologies meet the following standards:

- less than 1 mg/kg PCBs per kg of PCBs input to the system;
- particulate matter less than 50 mg per normal cubic metre (nm^3) of gas released;
- hydrogen chloride less than 75 mg/nm^3 of gas released; or
- 2,3,7,8-substituted PCDDs and 2,3,7,8-substituted PCDFs less than 12 ng/nm^3.

The Regulations require that all liquid emissions to the environment meet the following standards:

- PCBs less than 5 μg/L; or
- 2,3,7,8-substituted PCDDs and 2,3,7,8-substituted PCDFs less than 0.6 ng/L.

The Regulations require that all solid emissions to the environment meet the following standards:

- PCBs less than 0.5 mg/kg; or
- 2,3,7,8-substituted PCDDs and 2,3,7,8-substituted PCDFs less than 1 $\mu g/m^3$.

2.3.2 Provincial Environmental Legislation

The primary provincial environmental management legislation that is appropriate to the planning and implementation of the remediation project includes:

- *Environment Act*;
- *Dangerous Goods Transportation Act*; and
- *Beaches Act*.

A list of applicable provincial regulatory instruments and guidelines is included in Table 2.11 (from CBCL/ENSR, 2003a, 2003b).

TABLE 2.11 Provincial Environment Legislation

Legislation	Regulation, Permit Guideline, Code	Potential Related Activity Tar Ponds and Coke Ovens Remediation	Government Department or Agency	Requirement
NS Environment Act (NSEA)	Environmental Assessment Regulations	Remedial activities such as off-site treatment at new or significantly altered facilities in NS	NS Dept of Environment and Labour	Environmental Screening / Assessment
NSEA	Approvals Procedure Regulations Activities Designation Regulations	Includes alterations to watercourses, including diversions, placement of culverts, bridges, infills, etc., and development of new pits and quarries for construction and fill materials	NS Dept. of Environment and Labour	Approval
NSEA	Water and Wastewater Facility Regulations	Any new or altered facility for treatment of water	NS Dept. of Environment and Labour	Approval
NSEA	Sulphide Bearing Material Disposal Regulations	Excavation and disposal of acid producing bedrocks	NS Dept. of Environment and Labour	Compliance / Inspection / Approval
NSEA	Petroleum Management Regulations	Storage of fuels on-site for refueling equipment or operation of treatment facilities	NS Dept of Environment and Labour	Compliance / Registration
NSEA	Dangerous Goods Management Regulations	Transportation and storage of dangerous goods and waste dangerous goods	NS Dept of Environment and Labour	Compliance
NSEA	PCB Management Regulations	Storage and disposal in a landfill of PCB (>50 ppm) materials	NS Dept of Environment and Labour	Compliance
NSEA	Air Quality Regulations	Air emissions from on or off site incinerators or other thermal treatment /destruction facilities	NS Dept of Environment and Labour	Compliance
NSEA	Solid Waste-Resource Regulations	Disposal of waste materials at municipal solid waste disposal sites.	NS Dept of Environment and Labour	Compliance
NSEA	Water and Wastewater Facility Regulations	Quality of effluent from treatment facility wastewater streams	NS Dept of Environment and Labour	Compliance
NS Dangerous Goods Transportation Act	Dangerous Goods Transportation Regulations	Transportation of contaminated materials and dangerous goods to and from the site	NS Dept of Transportation and Public Works	Compliance / Approval
NS Endangered Species Act	Regulations	Any activity that threatens or disturbs designated endangered species and their habitats	NS Dept of Natural Resources	Compliance

TABLE 2.11 Provincial Environment Legislation

Legislation	Regulation, Permit Guideline, Code	Potential Related Activity Tar Ponds and Coke Ovens Remediation	Government Department or Agency	Requirement
NS Special Places Protection Act		Any activity that threatens or disturbs sites declared special places under the act (archaeological/cultural/ecological)	NS Dept of Natural Resources NS Museum of Natural History	Compliance / Archaeological Research Permit for surveys
NS Beaches Act	Regulations	Any sampling or remediation activity that takes place between the high and low tide mark of a marine or estuarine environment, including access by equipment	NS Dept of Natural Resources	Approval
NS Occupational Health and Safety Act	Regulations	All activities related to the health and occupational safety of workers in the Province.	NS Dept of Environment and Labour	Health and Safety Plan / Compliance
Guidelines and Policies				
Guidelines for the Management of Contaminated Sites in NS		If the project is determined to be in Provincial jurisdiction, the guidelines could apply to its overall management	NS Dept of Environment and Labour	Reference / Compliance
Standards for the Decontamination of Impermeable Surfaces Contaminated with Polychlorinated Biphenyls		Cleaning of contaminated debris excavated from the Tar Ponds	NS Dept of Environment and Labour	Reference / Compliance
Standards for the Decontamination of Impermeable Surfaces Contaminated with PCDDs or PCDFs		Cleaning of contaminated debris excavated from the Tar Ponds	NS Dept of Environment and Labour	Reference / Compliance
Guidelines for the designation of a Contaminated Site		If the project is determined to be in Provincial jurisdiction, the guidelines could apply to its overall management	NS Dept of Environment and Labour	Reference / Compliance
Policy for the Handling and Treatment of Petroleum Hydrocarbon Contaminated Soils containing PAHs		TPH and PAH contaminated soils movement, treatment and disposal	NS Dept of Environment and Labour	Reference / Compliance
Policy for Domestic Fuel Oil Spill		Reference for cleanup requirements for TPH contaminated soils	NS Dept of Environment and Labour	Reference / Compliance
Municipal Solid Waste Landfill Guidelines		Contaminated waste disposal	NS Dept of Environment and Labour	Reference / Compliance
Construction and Demolition Debris Disposal Site Guidelines		Disposal of debris excavated from the Tar Ponds, and/or from shoreline structures.	NS Dept of Environment and Labour	Reference / Compliance
Policy for Facilities for the Thermal Treatment of Soils		Thermal treatment and destruction of waste materials	NS Dept of Environment and Labour	Reference / Compliance

2.3.2.1 Environment Act (NSEA)

Regulations and policies promulgated under the *Environment Act* may have direct application to on-site activities and operations proposed as part of the remediation project, and will affect most off-site activities such as the transportation of hazardous materials, and off-site treatment and/or disposal.

Activities Designation Regulations And Approvals Procedure Regulations

A number of activities associated with the remediation project will require approvals under the *NSEA*. The *Activities Designation Regulations* provide activity classifications and identify actions that will require approval under the Act. Alterations to watercourses, including diversions, placement of culverts, bridges, infills, etc., require an approval under the *Approvals Procedure Regulations*. Prior to the issuance of such an approval, the Nova Scotia Department of Environment and Labour often requires documentation that any requirements related to the *Navigable Waters Protection Act* and the *Fisheries Act* have been or will be met. The Department may also require documentation from the Nova Scotia Department of Natural Resources to ensure that any permits and authorizations required under the *Beaches Act* have been received. Depending on jurisdictional status, Provincial approvals may also be required for activities such as on-site landfilling.

Air Quality Regulations

The *Air Quality Regulations* apply to the operation of controlled combustion units (i.e., furnaces, incinerators, and other approved devices). In addition to regulating the operation of these facilities through established criteria, the Province also adopts an annual sulphur dioxide emission cap for existing sources of emissions. The Nova Scotia Energy Strategy has set a policy that the cap will be reduced by 25% by 2005 and that emissions from existing facilities will be further reduced by 25% by 2010. The criteria for ambient air quality in Nova Scotia is expressed as Maximum Permissible Ground Level Concentrations; the criteria are detailed in Table 2.12. Provisions to ensure that these levels are not exceeded are contained in an approval issued by the Department of Environment and Labour.

TABLE 2.12 Maximum Permissible Ground Level Concentrations (NS)

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentration	
		μg/m^3	pphm
Carbon monoxide	1 hour	34,600	3000
	8 hours	12,700	1100
Hydrogen sulphide	1 hour	42	3
	24 hours	8	0.6
Nitrogen dioxide	1 hour	400	21
	annual	100	5
Ozone	1 hour	160	8.2
Sulphur dioxide	1 hour	900	34
	24 hours	300	11
	annual	60	2
Total suspended particulate (TSP)	24 hours	120	--
	annual	70	--

Notes: μg/m^3 – micrograms per cubic metre
pphm – parts per hundred million

Solid Waste-Resource Management Regulations: Municipal Solid Waste Landfill Guidelines, PCB Management Regulations and Guidelines for the Disposal of Contaminated Soils in Landfills

Approved landfills in the Province rely on these guidelines to determine which materials are suitable for disposal.

The *PCB Management Regulations* do not permit the disposal in a landfill of PCB materials (>50 ppm) unless that material is derived from a contaminated site, and is being placed in a permanent disposal facility at or near that site. An approval from the Department is required for the latter.

The guidelines state that materials containing PCBs in concentrations less than 50 mg/kg can be disposed of in landfills.

Soils containing petroleum hydrocarbons can be acceptable for disposal at approved landfills provided all of the petroleum hydrocarbons are fully absorbed in the soils (i.e., no free product is present) and the following criteria are met:

- The owner of the landfill agrees to take the material;
- Soils containing slight or moderate amounts of gasoline or a small amount of mid range petroleum distillate (i.e., furnace and diesel fuel) can be used for daily cover;
- Soils containing a large amount of petroleum hydrocarbon should be spread out and landfarmed. The material can later be used for daily cover (gasoline in soils disappears readily (less than one week) when spread thinly (less than 8 inches); and
- Bunker C or heavier oils in soil should be buried as degradation is slow and leachate concerns are lower and are not considered to be significant.

CBRM does not allow soils with free phase hydrocarbon product into landfills within their boundaries. Even if the materials to be landfilled satisfy the provincial guidelines, CBRM reserves the right to require further evaluation based on the Atlantic RBCA (Risk-Based Corrective Action) Tier I criteria to determine whether the material to be deposited can be accepted.

The above referenced guidelines establish 2 standards for determining the acceptability of scils contaminated with other parameters. Materials can be considered acceptable if the total concentrations of targeted contaminants are less than those identified in Table 2.13. Alternatively, materials can be considered acceptable if they meet the standards required by a leachate extraction test (Table 2.14). If the materials to be disposed fail both these standards, they can only be disposed in a hazardous waste secure landfill. There are currently no such facilities in Nova Scotia, and such materials have to be transported out of Province.

TABLE 2.13 Selected Acceptance Parameters for Contaminated Soils (Total Analysis)

Inorganic Parameter	Maximum Limit (mg/kg)	Organic Parameter	Maximum Limit (mg/kg)
Arsenic	50	Benzene	5
Cadmium	20	Toluene	30
Chromium (+6)	8	Ethylbenzene	50
Chromium (Total)	800	Xylenes	50
Cobalt	300	PAHs (each)	10
Copper	500	PAHs (total)	50
Cyanide (Free)	100	Aliphatic Hydrocarbons (each)	150
Cyanide (Total)	500	Phenolics (each)	10
Lead	1000	Chlorinated Aliphatics (each)	50
Mercury	10	Chlorobenzes (each)	10
Molybdenum	40	PCBs	50
Nickel	500	--	--
Selenium	10	--	--
Silver	40	--	--
Sulphur	500	--	--
Thallium	1	--	--
Vanadium	200	--	--
Zinc	1500	--	--

Source: Guidelines for Disposal of Contaminated Solids in Landfills (NSDEL, 1994)

TABLE 2.14 Selected Acceptance Parameters for Landfilling Contaminated Soils (Leachate)

Inorganic Parameter	Maximum Limit (mg/L)	Organic Parameter	Maximum Limit (mg/L)
Aluminum	500	Benzene	0.5
Arsenic	5	Toluene	2.4
Cadmium	0.5	Ethylbenzene	0.24
Chromium (+6)	0.5	Xylenes	30
Chromium (Total)	5	PAHs (total)	0.01
Cobalt	5	Aliphatic Hydrocarbons (each)	1.5
Copper	100	Phenolics (each)	0.1
Cyanide (Free)	4	Chlorinated Aliphatics (each)	0.5
Cyanide (Total)	20	Chlorobenzes (each)	0.5
Lead	5	--	--
Mercury	0.1	--	--
Molybdenum	5	--	--
Nickel	20	--	--
Selenium	1	--	--
Silver	5	--	--
Sulphur	50,000	--	--
Vanadium	10	--	--
Zinc	500	--	--

Source: Guidelines for Disposal of Contaminated Solids in Landfills (NSDEL, 1994).

Sulphide Bearing Material Disposal Regulations

There are regulations in place to reduce the impact of acidified surface drainage with respect to those areas of Nova Scotia where there is sulphide bearing aggregate (sulphide sulphur content equal or greater than 0.4 % (12.51 kg H_2SO_4/tonne). The Regulations require special treatment where the total volume to be excavated is greater than 500 m^3 *in situ*, or 1,300 tonnes. Special handling and disposal requirements include limitations on the area of exposed material, control of any runoff from the material and the site, and disposal only at a site approved by the Nova Scotia Department of Environment and Labour. Effluent from these areas must, at a minimum, meet specified criteria (i.e., pH>4.0, Aluminum<0.8 mg/L, conductivity<500 µmhos/cm) prior to discharge to the environment.

2.3.2.2 Dangerous Goods Transportation Act

The *Dangerous Goods Transportation Act* applies to the movement of all dangerous materials within the Province of Nova Scotia. Classification of dangerous goods in Nova Scotia has been harmonized with the requirements and classifications of the federal *Transportation of Dangerous Goods Act.*

2.3.2.3 Beaches Act

The *Beaches Act* provides for the protection of beaches and associated systems through the regulation and enforcement of land use activities on beaches. Beaches are defined under the Act as: "that area of land on the coastline lying to the seaward of the mean high watermark, and that area of land to landward immediately adjacent thereto to the distance determined by the Governor in Council, and includes any lakeshore area declared by the Governor in Council to be a beach".

The Act is administered by the Nova Scotia Department of Natural Resources and requires that an approval be obtained prior to the initiation of any activity within the defined area.

Government staff responsible for issuing approvals take care to ensure coordination with the requirements of Fisheries and Oceans Canada, appropriate Harbour Authorities, the Coast Guard (*NWPA*) and the Nova Scotia Department of Environment and Labour (watercourse alteration approval).

2.3.3 CBRM Bylaws and Guidelines

The CBRM has a range of municipal bylaws that may have application to the implementation of the remediation project. Of specific interest are the Building Bylaw, the Noise Bylaw (which may affect both hours of operation and/or the selection of equipment and associated methodologies), the Sewer Use Guideline and Wastewater Discharge By-Law.

Both the Tar Ponds and the Coke Ovens sites are currently zoned for industrial purposes. The CBRM, however, will be implementing a review of the municipal plan, which will involve a review of this designation. The review process under the requirements of the *Municipal Act* also requires that the planning authority, i.e., the CBRM, solicit public input into the revised plan and its associated zoning bylaw.

As it is unlikely that a residential zone would be the preferred choice for this area, it is unlikely that changes to the plan and zoning bylaw will affect the remediation project.

2.3.4 Joint Environmental Assessment Process

The *CEAA* requires that the federal environmental assessment process be applied when a federal authority is involved in a project. In some cases, both federal and provincial or territorial processes apply.

Given the potential for overlapping environmental assessments, the Act allows the federal Minister of the Environment to enter into agreements with provincial and territorial governments relating to the environmental assessments of projects where both governments have an interest. These agreements provide guidelines for the roles and responsibilities of each government in the assessment of such projects.

Provisions for such a "joint" process are included in the MOA in Appendix A.

The details and timelines of any joint environmental assessment process will be determined prior to initiating the EA.

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3.0 PROPOSED REMEDIATION OF THE TAR PONDS

This section of the Project Description report focuses exclusively on the Tar Ponds site remediation. Included in this section is a description of the overall remediation activities, including pre- and post-remediation activities that will be performed, off-site resource requirements, and schedule.

The Tar Ponds (including the North and South Tar Ponds) is the name given to a portion of Muggah Creek near the Coke Ovens Site that received industrial discharges from upstream industrial activities. Contaminants in the Tar Ponds include, primarily, PAHs, metals, and PCBs.

The North Tar Pond is open to Sydney Harbour and at high tide covers an area of 18.6 ha. It contains an estimated 360,000 tonnes (280,000 m^3) of contaminated sediments. Forty seven thousand tonnes (36,000 m^3) (*in situ* volume) of PCB sediment in the North Tar Pond lies in a discreet layer of varying thicknesses (up to 4.9 m) that is located between layers of PAH sediments.

The South Tar Pond is separated from the North Tar Pond by a man-made cofferdam and covers an area of 12.9 ha. It contains an estimated 350,000 tonnes (270,000 m^3) of contaminated sediments. Twelve thousand tonnes (9,000 m^3) of PCB sediment in the South Tar Pond is primarily located close to the surface of the sediment in a relatively accessible location.

The site will be remediated using a variety of techniques to prevent any further off-site contaminant migration and future risk of exposure to the community and the environment. The remediation activities to take place at the Tar Ponds site are summarized in Table 4.1.

TABLE 3.1 Proposed Remediation Program – Tar Ponds

	Activity	Description
1.	Control Water	Construct watercourse diversion channels to redirect surface water flowing through the Tar Ponds. This will isolate brooks and streams from contaminated Tar Pond sediments.
2.	Remove and Destroy Selected Contaminants	Excavate, dredge, and dewater 120,000 tonnes (92,000 m^3) (*ex situ* volume) of sediment containing PCB material and destroy the dewatered sediment in an approved temporary PCB incinerator that will be constructed offsite in Industrial Cape Breton.
3.	Solidify / Stabilize Contaminated Sediments In-place	Solidify and stabilize, in-place, the top 1 to 2 m of remaining sediment with a binder (such as Portland cement) using on-site auger or grout injection systems.
4.	Contain Residual Contaminants	Install a containment system designed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability barrier walls installed at various locations around the perimeter of the Tar Ponds and an engineered cap.
5.	Site Surface Restoration and Landscaping	Site restoration and landscaping will be compatible with the natural surroundings and future use.
6.	Long-term Monitoring and Maintenance Plan	Monitor air quality, water quality, sediment, biota and the performance of the containment system after completion of the project.

The features of the site, the location of selected contaminated areas, and the proposed remedial activities are provided in Figure 3.1. Cross sections of the Tar Ponds showing the locations of the contaminated materials are shown in Figure 3.2

Generally, the remediation requires 2 steps: 1) removal and/or treatment of contaminants followed by 2) containment of residuals in-place.

Approximately 120,000 tonnes (92,000 m^3) (*ex situ* volume) of PCB sediments will be excavated and dewatered, then transported by rail or road to a temporary, fully approved incinerator. This incinerator will be located on a site (see Appendix B) that has been carefully selected in accordance with strict regulatory requirements. The incinerator will be operated, maintained, and monitored in accordance with the regulatory requirements and accepted operational practices. The top 1 to 2 m of the remaining sediments in the Tar Ponds will be solidified / stabilized in-place and contained by the installation of engineered structures. The majority of the Tar Ponds site will then be capped to contain any further migration of contaminants and reduce the risk of exposure to both the community and environment.

Further details are provided in subsequent sections.

3.1 PRE-REMEDIATION ACTIVITIES

The following information describes activities that will be completed prior to physically beginning the remediation of the Tar Ponds.

3.1.1 Environmental Management Plan

An Environmental Management Plan (EMP) for remediation of the Tar Ponds is included as Appendix C. Mitigative measures identified during the EA process will be incorporated into the EMP.

3.1.2 Health and Safety Plan

A Master Health and Safety Plan will be developed for the site that will cover all phases and elements of the remediation project. The Master Health and Safety Plan (HASP) will be developed by a health and safety professional to ensure adequate precautions are taken for the protection of workers and the general public. It will include a worker-monitoring program including medical checks before, during, and after completion of the work. The Plan will be modified over the life of the project as new information becomes available for improved worker protection. The objectives of the plan will be to:

- define activities which are likely to represent risks to worker safety and health, requiring planning, design, inspection or supervision by an engineer, competent person (as defined by regulations) or other professional;
- provide guidelines for completing a project health and safety analysis at initiation and at critical stages of the project;
- establish a decision-making process to identify worker and public protection measures;
- Establish supervisor and employee training requirements according to the project plan including recognition, reporting and avoidance of hazards, and knowledge of applicable Standards and the project-specific HASP;
- provide general guidelines for controlling the most commonly identified hazardous operations, such as: cranes, scaffolding, trenches, confined spaces, hot work, explosives, hazardous materials, leading edges, etc.;

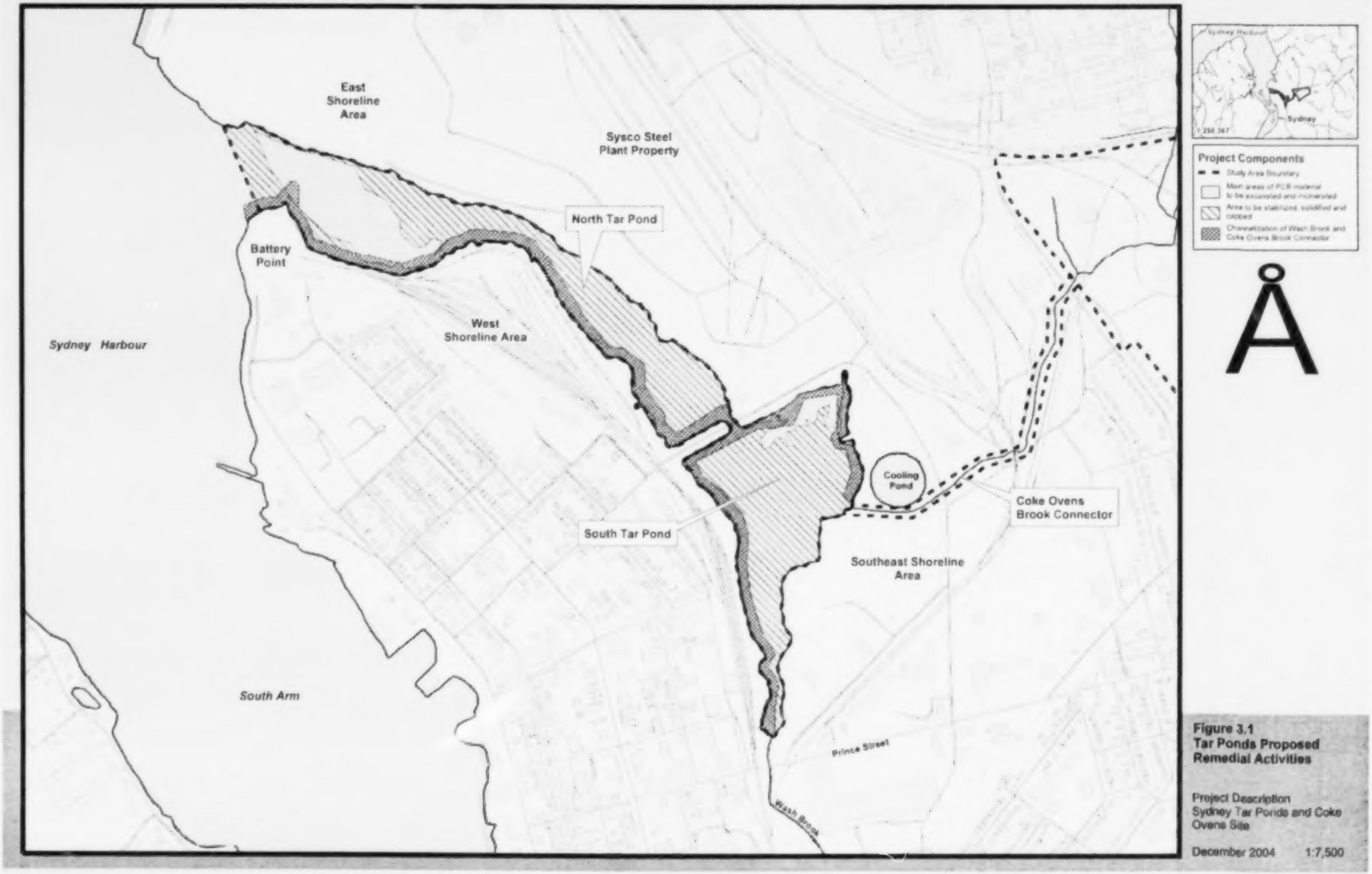
East Shoreline Area
Sysco Steel Plant Property
North Tar Pond
Battery Point
West Shoreline Area
Sydney Harbour
South Tar Pond
Cooling Pond
Coke Ovens Brook Connector
Southeast Shoreline Area
South Arm
Prince Street
Wash Brook
Sydney Harbour
Sydney
1:250,367
Project Components
Study Area Boundary
Main areas of PCB material to be excavated and incinerated
Area to be stabilized, solidified and capped
Channelization of Wash Brook and Coke Ovens Brook Connector

Figure 3.1
Tar Ponds Proposed Remedial Activities

Project Description
Sydney Tar Ponds and Coke Ovens Site

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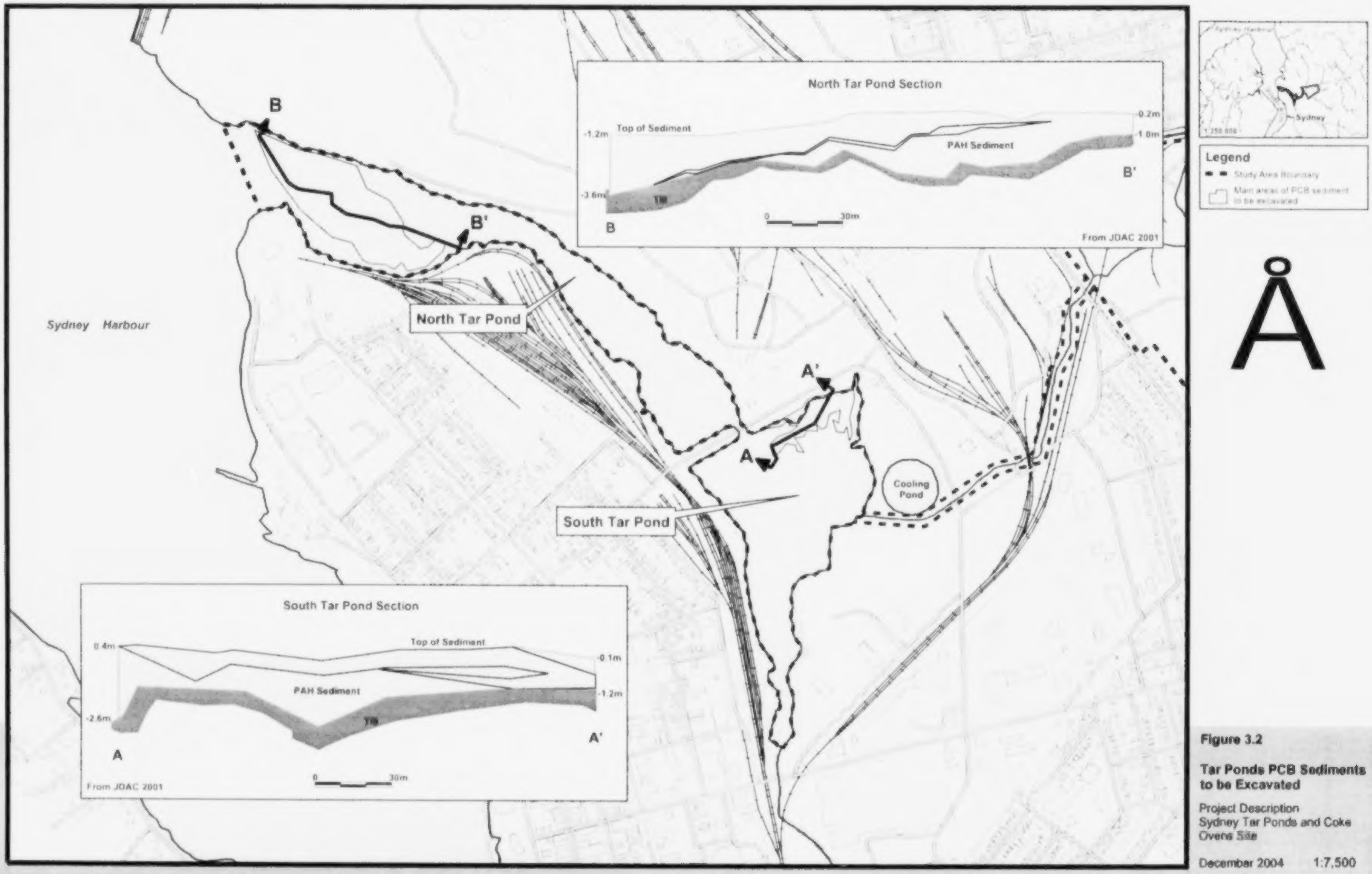
Sydney Harbour
1:250 000
Sydney
Legend
Study Area Boundary
Main areas of PCB sediment to be excavated
B
B'
A
A'
Sydney Harbour
North Tar Pond
South Tar Pond
Cooling Pond
North Tar Pond Section
-1.2m
Top of Sediment
-0.2m
-1.0m
PAH Sediment
-3.6m
Till
B
B'
0
30m
From JDAC 2001
South Tar Pond Section
0.4m
Top of Sediment
-0.1m
PAH Sediment
-1.2m
-2.6m
Till
A
A'
0
30m
From JDAC 2001

Figure 3.2

Tar Ponds PCB Sediments to be Excavated

Project Description
Sydney Tar Ponds and Coke Ovens Site

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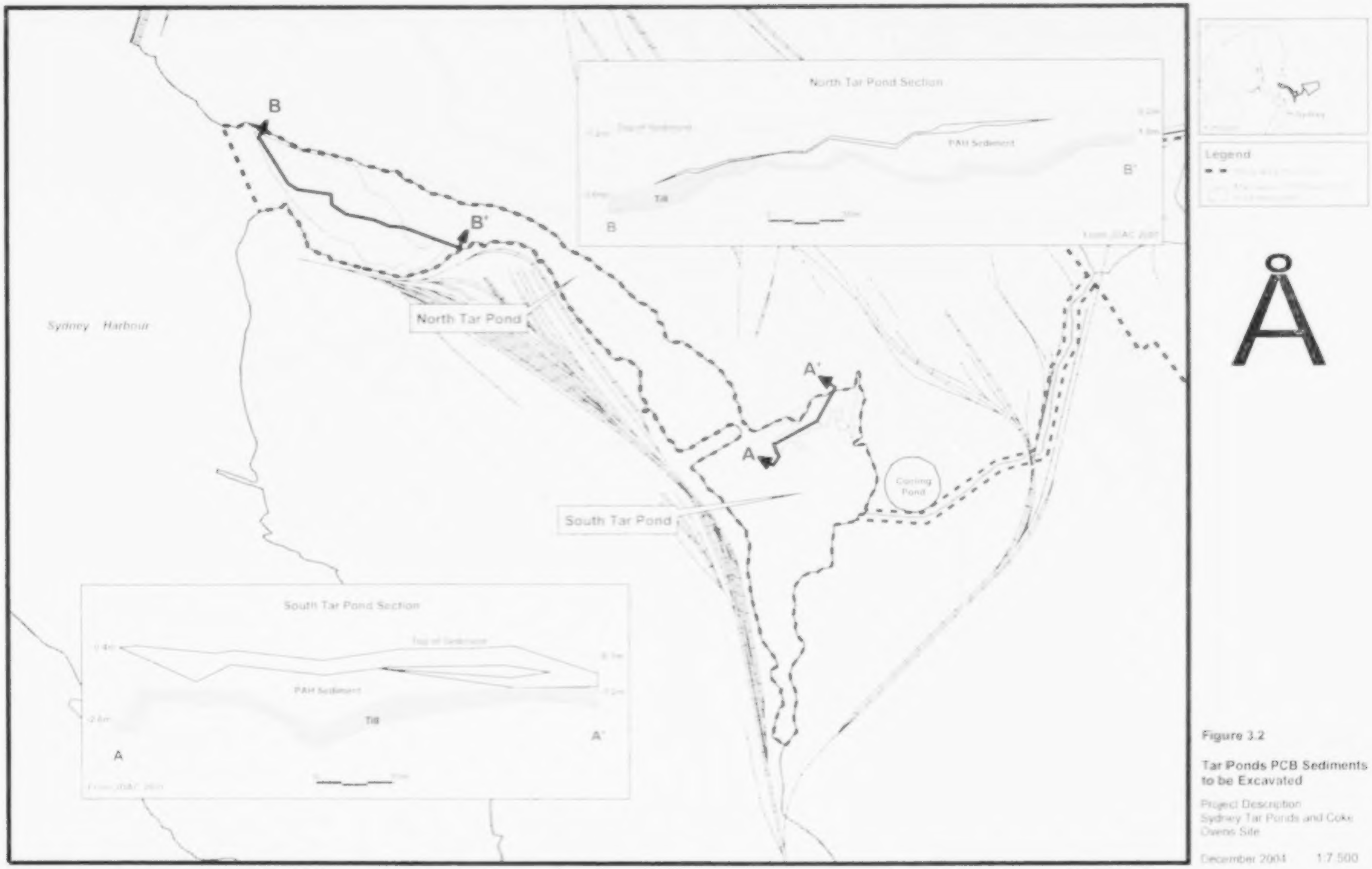
B
B'
A
A'
North Tar Pond
South Tar Pond
Sydney Harbour
Cooling Pond
North Tar Pond Section
Top of Sediment
PAH Sediment
Till
B
B'
South Tar Pond Section
Top of Sediment
PAH Sediment
Till
A
A'
Sydney
Legend

Figure 3.2

Tar Ponds PCB Sediments to be Excavated

Project Description
Sydney Tar Ponds and Coke
Ovens Site

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- establish processes to ensure that hazards are identified and corrected with preventive measures that are implemented in a timely manner;
- provide a process for reporting near-misses and accidents;
- identify documentation requirements for training, permits, hazard reports, inspections, uncorrected hazards, incidents and near misses;
- establish the need for project-specific emergency response plans;
- define the requirement for a designated competent person responsible for and capable of implementing the program/plan;
- establish a communications plan to provide preventative and emergency information to the general public;
- provide information to the public on guidelines for completing a project health and safety analysis at initiation and at critical stages of the project;
- establish a decision-making process to identify public protection measures; and
- provide public information regarding measures taken to prevent hazards, requirements according to the project plan, reporting and avoidance of hazards, and knowledge of applicable Standards and the project-specific HASP.

Each contractor and consultant retained for the project will be required to submit for review, a Project-specific HASP for its workforce, and will be responsible for its implementation. The HASP will meet the requirements of the Master HASP. Audits will be completed to ensure compliance with the Project-specific HASP.

The Master HASP will identify adequate precautions to be taken for the protection of the general public. It will include a monitoring program and communication plan for providing information to the general public. The Plan will be modified over the life of the project as new information becomes available.

3.1.3 Site Infrastructure

Prior to commencing remediation activities, general site infrastructure will be designed and constructed at the Tar Ponds site. Facilities will be constructed both inside and outside of the contaminated area. These will include:

- Parking lots for employee and visitor vehicles outside of the contaminated areas;
- Storage areas on and off the sites for equipment and supplies;
- Security facilities to control and log the entry and exit of personnel and vehicles to the contaminated sites. The security will be in the clean zone to ensure authorized entry. Vehicles and personnel leaving the site will go through decontamination facilities prior to exiting via the security building;
- Offices, washrooms and lunchrooms outside of the contaminated zone. Personnel will have access to safe, clean facilities for meals and hygiene;
- Decontamination facilities for personnel to leave the contaminated area. This will include a soiled clothing change area, showers, and a street clothes change area. Sufficient storage will be provided for retaining soiled personal protective equipment

such as coveralls and gloves prior to disposal. Disposal will be accomplished by incineration (during incinerator operation) or off-site at an approved facility prior to or after the incinerator is operating. Water from showers will be directed to the water treatment plant. Safety equipment that will be re-used will be directed to a designated area and subsequently decontaminated and approved for re-use;

- Buildings for the storage of tools, specific replacement parts, and repair and maintenance of equipment (such as excavators). Once heavy equipment is on the contaminated site, the goal will be to complete routine maintenance on-site; otherwise it will be thoroughly decontaminated before removing from the site. Maintenance and repair personnel will be provided by the contractor and will be required to abide by the HASP as well as be capable of conducting repairs while wearing approved safety equipment;
- Utilities such as potable water, sanitary sewage and electricity. Much of this infrastructure will be installed prior to tendering of specific contracts. Selected contractor(s) will address the service requirements of specific treatment technologies or construction activities. Where possible, below grade installation will be avoided, however, some below grade installation is necessary and will require proper management of any impacted materials encountered;
- Equipment decontamination pads for cleaning equipment (daily, as required) or prior to leaving the site; and
- One or more isolation pads to retain materials prior to them leaving the site. The pads will allow materials or equipment to be quarantined until sample test results confirm that they can safely be removed from site. The isolation pads will be self-contained to include the control of impacted water, dust, and odour.

3.1.4 Water Treatment Plant

Water treatment will be required to handle contaminated water pumped from the Tar Ponds site. Treatment will be required to ensure 1) that liquid effluent discharges are in compliance with the pollution prevention provisions of the *Fisheries Act* and 2) discharges will not cause an exceedance of the receiving environment water quality objectives.

It is assumed that wastewater will need to meet, at a minimum, the acute lethality test (*Fisheries Act*) and should not cause chronic effects. If discharged to a municipal sewer leading to a treatment plant, the wastewater will meet the appropriate sewer discharge standards. It is anticipated that specific discharge standards will be developed in conjunction with the appropriate regulatory agencies prior to the start-up of the remediation project. Sampling and analysis will be conducted to ensure any required discharge criteria are met.

Remediation activities could generate large quantities of wastewater from various sources:

- Between 200 and 400 L/min of wastewater will be generated as the dredged materials will be removed from the Tar Ponds and/or processed for further transportation, treatment/ destruction (CBCL/ENSR, 2003a, 2003b);
- Disturbance and/or agitation of the sediments during extraction and handling, washing of extracted debris, and other processing activities could result in the resuspension of sediments and contaminants in the decanted water;

- Decontamination pads at the Tar Ponds and the incinerator will produce contaminated wastewater; and
- Surface water and process water from the incinerator site will also require treatment.

Contaminants that could occur in the wastewater streams include petroleum hydrocarbons, PAHs, metals, PCBs, dioxins, furans, and pathogens. The parameters to be monitored in the effluent will be prescribed by the relevant regulatory authorities.

The feasibility of having a single treatment plant to handle both the Tar Ponds and Coke Ovens sites or having independent treatment plants for each site will be determined during the engineering design stage. A water treatment plant will be a long-term fixture for treatment of contaminated groundwater at the Coke Ovens site and this will be a factor in the decision. Advantages of having a single plant are reduced capital and operating costs. These costs could be offset by the increased pipeline or transportation requirements between sites. Water treatment facilities are currently available on the SYSCO site, and those facilities will be evaluated in the design phase to determine if they can be used in conjunction with additional treatment units.

Water treatment systems for this purpose can be purchased from suppliers as a series of prefabricated process units that are installed on a concrete pad. The treatment process typically consists of the following basic steps:

- Equalization using a tank or series of tanks to minimize flow variations and to isolate different wastewater streams;
- Batch treatment depending on the contaminant of concern that requires removal from the wastewater;
- Gravity settling for suspended solids removal. Floating oil will be removed for destruction in the incinerator (during incinerator operation) or disposed of through a local licensed contractor;
- Biological treatment to oxidize much of the soluble organics followed by gravity settling or filtration to remove the biological solids;
- Polishing of effluent using sand filters, micron bag filters, and activated carbon to remove dissolved organics prior to discharge; and
- Use of large aboveground storage tanks for the containment of treated effluent while awaiting analysis. Release of effluent will be permitted only upon receipt of acceptable analytical results and only when a release form has been properly completed and the appropriate signatures affixed.

Once a fully approved treatment plant(s) have been installed, direct discharge will take place.

3.2 REMEDIATION ACTIVITIES

3.2.1 Control Groundwater and Surface Water

Surface waters flow into the South Pond from Wash Brook and Coke Ovens Brook and empty into North Pond via the weir at the Ferry Street cofferdam. Stormwater and sanitary sewers also empty into the Ponds at a number of locations. Once in operation (Spring 2005), the newly constructed interceptor sewer will redirect combined sewer and sanitary outfalls away from the

Ponds, hence eliminating typical urban contaminants such as sediments and nutrients contained in this source. It should be noted that periodic overflows from the interceptor sewer might discharge to the brooks and ponds.

The continued discharge of potentially contaminated surface run-off and groundwater, together with the potential for high flow conditions during peak storm events, could create difficult, and on occasion, hazardous working conditions during soil excavation and/or remediation.

Surface water and groundwater controls will be used to minimize the overall water treatment requirements, facilitate access to specific areas requiring remediation, mitigate potential impacts to receiving water bodies, mitigate potential exposures to on-site and off-site receptors, and to prevent recontamination of the remediated areas. These controls will be implemented before, during, and after the remediation project.

One of the first steps in the Tar Ponds Remediation Project will be to redirect surface water flows and outfalls to new channels designed to carry the water through the Tar Ponds to a discharge point into Sydney Harbour near Battery Point. When surface water and groundwater controls are required, they will be used to:

- minimize the overall water treatment requirements;
- facilitate access to specific areas requiring remediation;
- mitigate potential impacts to receiving water bodies;
- mitigate potential exposures to on-site and off-site receptors; and
- prevent recontamination of the remediated areas.

These controls will be implemented before, during, and after the remediation project.

New channels will be created to isolate surface water flows from Wash Brook and Coke Ovens Brook from the rest of the Tar Ponds. The new channels will be constructed using common construction techniques such as sheetpiles, portable dams, earthen berms, and impermeable liners to restrain flows and prevent contact with the water of the Tar Ponds. These will be installed using conventional construction equipment such as pile drivers and excavators. Prior to construction, and as appropriate, contaminated sediments in the area of the diversions will be removed for treatment.

The potential flow of groundwater into the work areas from upgradient locations will be addressed through the installation of a series of vertical barrier walls and/or diversion trenches (see Figure 3.1 and Section 3.2.4.3).

3.2.2 Remove and Destroy Selected Contaminants

The removal and destruction of PCB sediments will involve 4 main actions:

- Dredging/excavating of PCB sediments from the Tar Ponds;
- Dewatering of excavated sediments on or near the Tar Ponds;
- Transportation of dewatered sediments to the incinerator; and
- Incineration of transported sediments (see Section 5.0).

3.2.2.1 Dredge/Excavate Sediment

One hundred and twenty thousand tonnes (120,000 Te) (92,000 m^3) of PCB sediments in the Tar Ponds (*ex situ* volume) will be removed by excavation or mechanical dredging and placed in watertight containers.

Dredging/excavating sediments containing PCBs from the Tar Ponds will be conducted using combination of conventional shore-based and water-based technologies (e.g., excavators, barges, clamshell dredges) from within defined and segregated areas. Sheet pile cofferdams or other similar methods will be installed around areas to be dredged/excavated to control water to and infiltration of adjacent sediments. This will allow, for the most part, for sediment excavation to take place under relatively dry conditions. Sediment removal activities could operate an average of 12 hours per day, 6 days per week, for 9 to 10 months per year. A 2 to 3 month shutdown has been assumed for winter months, and to allow for equipment maintenance. The average dredging rate could vary from a low of 400 to a high of 1500 tonnes per day (wet weight).

The South Pond is known to contain 9,000 m^3 (12,000 Te) of PCB sediments in relatively well-defined areas in the surficial layers of the bottom sediments. These areas will be among the first sediments to be excavated. Removal systems will include both shore-based and barge-based technologies. Excavated PCB sediments will be moved to a land location near the Ponds for initial processing to remove debris and water. The PAH sediments in the South Pond will remain largely in place. The exception will be those contaminated sediments that should be removed prior to the construction of watercourse diversion channels. These sediments will be excavated and placed at a designated location in the South Pond and will be later solidified.

The North Pond has 36,000 m^3 (47,000 Te) of sediments containing PCBs located in several thin layers. Sediments will be removed from the North Pond using a dredge or an excavator. A dredge might be necessary due to the fluctuating tidal water levels. Dewatering of the sediments from the North Ponds will be similar to that described above for those from the South Pond.

Dredging/excavating has a high potential to resuspend sediments and increase water column concentrations of PCBs and PAHs downstream of the site. Water column impacts during dredging will be reduced through an effective turbidity control system, such as berms, sheet piles, and/or containment curtains.

Barges could be used to hold temporary containers for storing dredged materials. Such containers will be covered and/or sealed to manage odours and emissions and minimize infiltration during precipitation events. The containers could then be transported with minimal loss of either materials or emissions from the barge to the pre-treatment location.

3.2.2.2 Dewater Sediment

Dredged material removed from the Ponds will not be suitable for direct transportation or feed into an incinerator. It will be necessary to alter water content, maximum and minimum or average particle size, and uniformity with respect to heating value before the dredged material can be incinerated. Decreased water content in the feed material to the incinerator will result in a lower cost of incineration. Sediment pre-treatment systems will address several issues and requirements, including:

- Water treatment;
- Exposure of workers and others to sewage-related pathogens;
- Control of odours or vapours that could result from pre-treatment;
- Storage of dredged materials so that downstream treatment processes will be fed at a constant rate;
- Transporting of dredged material to, within, and from the pre-treatment area; and
- Winterizing to prevent freezing.

There are a variety of passive and active treatment options for dewatering sediments. The ease and rate of dewatering will be a major factor in determining the cost and time frame of a sediment remediation. Site-specific pilot testing of various technologies will be performed during the design, or pre-construction phases of a project. The project requirement for sediment dewatering will be tied to the throughput rate of the incinerator. Assuming an incinerator throughput of 10 tonnes per hour (for 24 hrs/day), a minimum dewatering rate of 20 tonnes per hour (for 12 hrs/day), or slightly greater, will be required.

Passive (i.e., non-mechanical) dewatering relies on drainage and natural evaporation to lower the moisture content. Components of passive dewatering techniques include primary settling, surface drainage, subsurface drainage, consolidation, and evaporation. These components, generally, will require a significant amount of land adjacent to the Tar Ponds. A common passive dewatering technique uses drying beds. Drying beds consist of pads where piles of materials are allowed to release free-standing water. Passive dewatering of sediments is expected to take between 24 and 48 hours. Active (i.e., mechanical) dewatering using belt filter presses could be employed to speed up the dewatering process.

Sediment dewatering will generate large quantities of wastewater as the dredged materials are removed from the water body, stored in containers, stored on land, and processed for transportation and destruction. A water treatment plant, as described in Section 3.1.4, will also receive wastewater from sediment dewatering activities.

3.2.2.3 Transport Sediment to Incinerator

All dewatered sediments removed from the Tar Ponds and identified for incineration (see Section 5.0) will be transported by truck or railcar to the off-site incinerator where they will be destroyed. The final method of transport will be determined based on an assessment of numerous factors, including the distance to the incinerator site and available facilities such as rail lines and access roads.

3.2.3 Solidify / Stabilize Contaminated Sediments In-place

The upper 1 to 2 m of residual contaminated sediments at the North and South Tar Ponds will be solidified and stabilized in-place. Solidification involves the use of a reactive additive, such as Portland cement, hydrated lime, lime kiln dust, or fly ash to increase strength, reduce permeability, and decrease contaminant mobility. Stabilization, on the other hand, uses similar additives to chemically stabilize contaminants through direct incorporation into the matrix, weak bonding, or entrapment. If both are accomplished, the treatment technology is referred to as solidification/stabilization.

The primary purpose for solidifying the top 1 to 2 m of sediments in the Tar Ponds is to provide the increased structural strength necessary to support construction equipment during capping and containment activities. A secondary benefit of solidifying the sediments is to decrease the mobility of contaminants.

The stabilization and solidification will be performed using one or more of several methods. One method of mixing consists of cutting and mixing blades on a vertical auger. Binding agents are conveyed to the mixing zone through conduits in the auger. Treated soil columns are typically 900 mm in diameter and are positioned in an overlapping pattern of columns. Other methods include using excavators with rakes to mix reagent with the sediment, or dry reagent injection systems. Excavation of some debris (e.g., large pieces of metal) from the Ponds might be necessary prior to solidifying the sediments to provide unobstructed access for the equipment.

In the case of organic contaminants, the inclusion of activated carbon or organic clay, in addition to the reactive reagent, encourages sorption of the organic components. The carbon or clay particle is bound to the hydrated reagent matrix. Varying the amount of reagent relative to the moisture content in the material requiring treatment produces a range of product consistency, from a loose soil to a solid block, similar to pure Portland cement. Treatment will also increase the volume by approximately 40%, which will decrease the amount of fill used at the site.

In situ solidification/stabilization will be relatively easy to implement in the South Pond because of the shallow water depth. Although the depths of the water in most of the North Pond are also relatively shallow, application of *in situ* solidification/ stabilization from shore will be difficult as the water depths increase. North Pond water depths may be too shallow for barge work, particularly once the sediments are bulked by the solidifying process. Essentially, it will be necessary to add enough bulking and binding agents into the sediment so that the surface of the solidified sediment is sufficiently shallow at high tide to permit tracked equipment to work on the solidified surface. Otherwise, a method of water level regulation will be required (e.g., pumping water from working areas or impermeable barriers around work areas) to facilitate the solidification process.

Successful completion of solidification and stabilization will be verified through quality control inspections, sampling, analysis and testing of the stabilized waste samples. Uniformity of the solidified waste will be verified by visual inspection of waste samples (to ensure reasonable uniform mixing of the waste with the design stabilization mix thereby, accomplishing adequate stabilization/solidification of the contaminated waste).

Sampling and testing will be performed in accordance with the following procedure:

- Final solidified/ stabilized waste samples will be collected in the field during treatment, inspected for homogeneity and voids that could affect the quality of the stabilized material, and then tested for conformance with the acceptance criteria.
- Sample sizes, curing, and testing shall meet the applicable American Society of Testing and Materials (ASTM) standards and other applicable standard requirements.
- Sampling and laboratory testing requirements will meet the level of quality control, practice, accuracy, and precision as prescribed in the applicable ASTM Standard Test Method.

The performance requirements will be designed based on the results of a treatability study and appropriate guidance documents. Tests for 28-day compressive strength and leachability will be used as the primary acceptance criteria for the solidified sediment. Secondary criteria will include hydraulic conductivity, pH, temperature, gas generation, effects of nitrite/nitrate, sulfite/sulfate, strength of the stabilization/solidification waste under immersed conditions, etc.

3.2.4 Contain Residual Contaminants

Residual contaminants at the Tar Ponds site will be isolated using a containment system designed to reduce the possibility of human and ecological exposure to the contaminants as well as to prevent the movement of the contaminants off-site. In-place containment will involve the construction and placement of barriers that block the pathway between the contaminant source and the receptor. The barriers will be designed to remain in-place permanently.

An engineered surface cap (see Section 3.2.4.1) will be placed over the Tar Ponds following removal of the PCB sediments and solidifying and stabilizing the upper 1 to 2 m of the remaining sediments. A subaqueous cap (see Section 3.2.4.2) will be placed over remaining sediments in excavated areas of the diversion channels and in deepwater areas of the North Pond. Low permeability vertical containment walls (see Section 3.2.4.3) will be constructed along the shoreline of the Tar Ponds to prevent off-site groundwater from flowing onto the site and potentially contacting contained contaminants (see Figure 3.1).

Containment technologies effectively manage exposure risks, can be implemented in a timely manner, and are generally economical. Capping and containment constitute one of the most common methods for dealing with hazardous wastes, especially at sites where large volumes of material needs to be managed. This method has been successfully used throughout North America on sites similar to the Sydney Tar Ponds and Coke Ovens (STPA, 2004). Capping and containment were successfully used in Sydney on the old municipal dump.

3.2.4.1 Surface Cap

The cap on the Tar Ponds site will be designed to limit the migration of contaminants upwards to the environment and potential receivers and to limit the infiltration of precipitation through the cap. The cap will also be designed to limit the potential for plant roots, burrowing animals, etc. to physically penetrate the cap.

The capping will likely be constructed using a combination of geotextiles, clay, and granular fill. The geotextiles will be pulled across the solidified sediments and then initial finger berms of clay and/or granular fill will be spread using low-ground pressure bulldozers to confine and tension the geotextiles. An initial lift of approximately 0.5 to 1.0 m of clay and granular fill will then be spread across the fabric. As capping material is placed, the water depth will become shallower so that much of the Ponds will likely become exposed at low tide after the first lift is placed.

In areas of the pond with standing water, even at low tide, alternate methods of material placement might be required for the initial lift. These will use placement by crane or even hydraulic sluicing or spraying of the material onto the geotextile. Due to the presence of sediments, the water depths in the Ponds are sufficiently shallow that routine barge work for capping will likely only be feasible in portions of the north end of the North Pond.

A second lift of granular fill will be placed to provide additional protection and ensure confinement of the sediments. Upon completion, the surface of the cap will either be raised so that it is above the high tide mark, or it will be left at an elevation where much of it will be inundated at high tide, similar to many salt marshes.

The cap surface will be protected from erosion by the cofferdam at Battery Point (see Section 1.9). Rip-rap or other armoring will be used as needed to manage erosion from waves, storm surges, or floods. Armoring will be provided along the waterway channels in Muggah Creek as needed to prevent erosion. It is expected that vegetation alone will likely prevent erosion over most of the area of the capped Tar Ponds.

Rigorous construction quality assurance and quality control procedures will be developed during the design process and will be implemented during construction. In addition, a monitoring plan to confirm the performance will be developed.

3.2.4.2 Subaqueous Cap

A subaqueous cap (see Figure 3.1) will be installed where the sediments are located in deeper water, or where a thin capping layer would be adequate (i.e., over remaining sediments in excavated areas of the diversion channels and in deepwater areas of the North Pond). The finished surface of the subaqueous cap would remain entirely underwater.

The cap materials will be sized to address the potential need for a barrier between the residual contamination and ecological receptors. The cap materials will also be sized to resist erosive forces and to provide habitat niches for re-colonization by marine and estuarine species. It is estimated that the subaqueous cap will be approximately 0.3 to 0.45 metres in thickness. The cap materials will be placed from a shallow draft barge, or land-based equipment from the shore.

The cap design and construction will consider the following:

- Prevent exposure of the underlying sediments. The gradation of the cap material (i.e., the size of the particles) will be selected to prevent the migration of solids up through the cap and to prevent erosion of the cap. Key considerations include the water currents, which have the potential to erode the cap, and possible end uses, which could disturb the cap.
- Method of placement to ensure integrity of the cap and prevent mobilization of contaminated sediments. For example, construction methods will be selected to reduce the potential for resuspension of underlying sediments.
- Mobilization due to organisms living in the cap. Organisms that burrow into the cap could mobilize underlying sediments if the thickness of the cap is insufficient.

3.2.4.3 Vertical Cut-off Wall Installation

Vertical cut-off walls (see Figure 3.1) will be used along the shoreline of the Tar Ponds site to control the movement of clean and contaminated groundwater and contaminants.

Vertical cutoff walls may be constructed of materials such as:

- Sheet pile, which is available as vinyl or steel and will be driven from the surface to the final depth. Alternatively, depending on depth, the sheet pile can be placed in an excavated trench and backfilled. The sheet pile and clean backfill will be imported to the site.

- Bentonite or cement walls, which are typically excavated, mixed, and backfilled with bentonite or cement. The equipment used is similar to conventional earth moving construction equipment (e.g., dozers, excavators). The bentonite, and possibly backfill, will be brought onto the site.
- Low permeability soil, where the depth to the confining layer is suitably shallow. Conventional earth moving equipment will be used to excavate a trench and backfill it with low permeability soil (e.g., clay). Clean low permeability soil will be imported to the site.
- A geomembrane or a geosynthetic clay liner could also be used as a vertical cutoff wall. In this case, an open trench will be excavated, the geomembrane or geosynthetic clay liner will be placed along the wall of the trench and the trench will be backfilled. The geomembrane or geosynthetic clay liner and clean backfill will be imported to the site.

A rigorous construction quality assurance program will be established throughout any or all methods of construction.

In addition, a monitoring program to confirm the long-term performance will be developed. Performance objectives will include limiting contaminant migration and migration of water onto the site.

3.2.5 Monitoring

Various monitoring programs will be implemented during the remediation project, several of which are mentioned below. Detailed environmental and health and safety monitoring programs will be developed prior to beginning the remediation activities.

- Sediment: Removal, treatment, and/or solidification and stabilization of contaminated sediment identified during previous site assessment activities will be the primary focus of remediation activities. Sampling and analyses of sediment will be conducted as needed during and after site excavation, but prior to backfilling, solidification, and capping to assess the completeness and effectiveness of procedures. Sampling and analyses of solidified materials will also be required.
- Air, Groundwater, Surface Water, Biota: Monitoring of air, groundwater, surface water, and biota during remedial activities at the Tar Ponds site will be conducted on a regular basis as part of the ongoing monitoring program as well as short-term tests conducted during critical operations. Benthic surveys and/or fish tissue analysis will be undertaken in the long term to confirm the performance of the remediation.
- Employee Health and Safety Monitoring: Employee Health and Safety will be conducted as per the Master Health and Safety Plan developed for the site.

3.3 POST- REMEDIATION ACTIVITIES

3.3.1 Equipment Removal and Decontamination

In cases where contaminated equipment or buildings are to be re-used, contamination will be removed by various decontamination methods. If the incinerator is operating, it may be more cost effective to simply send the item for incineration, especially if experience indicates difficulty in decontamination.

Specific surface decontamination criteria will be identified. Swab samples of the surfaces of decontaminated equipment will be collected and analysed prior to release from the site or reuse in a clean area. Surfaces not meeting the decontamination level will be recleaned.

A formal Release Form with appropriate signatures will document this process and decontaminated equipment will be safely and confidently released from the site or reused.

3.3.2 Removal of Site Facilities

At the end of the remediation, the facilities used for the remediation will be removed

- Building and Structures: Buildings and structures that have the potential for contamination will be cleaned prior to demolition. Swab samples will be taken over the surface areas to confirm that they meet site decontamination criteria. Scrap materials will be salvaged where possible and the remaining debris will be disposed at a licensed facility. Where decontamination is impossible or impractical, the materials will be transported to a hazardous waste facility.
- Parking Lots, Equipment and Materials Storage Areas: Gravel, paving, or concrete from these areas will be removed and the ground surface will be restored with vegetation.
- Maintenance and Repair Areas: These will be decontaminated and removed from the site. Swab samples will be taken to confirm the method of disposal.
- Security: Security kiosks and facilities will be removed and reused where possible. Fencing that is not used in the future redevelopment will be removed and recycled.
- Municipal Services (Power, Potable Water, Sewage): Buried utilities on contaminated areas of the site will be left in-place at the end of the remediation but will be disconnected and capped. Utilities installed in non-contaminated areas of the site will be removed unless there is a need to retain them in the redevelopment.
- Decontamination Facilities (Personnel and Equipment): These facilities will be decontaminated and removed from site.
- Offices, Washrooms, Lunchrooms: These facilities will be removed from site unless they will be utilized in the redevelopment.

3.3.3 Removal of Hazardous Materials

Any hazardous materials that cannot be incinerated (such as where the incinerator is not approved to deal with the hazardous material or the incinerator has been shut down) will be managed and disposed of on-site in an approved manner. Ideally, the opportunity for this to occur will be minimized as much as possible and full advantage will be made of the operational status of the incinerator as it "burns itself off the site".

3.3.4 Site Surface Restoration and Landscaping

Site restoration and landscaping will be compatible with the natural surroundings and future use. Regardless of the end use, consideration will be given to the following:

- The site will contain encapsulated and immobilized contaminants in the subsurface under an engineered cover.

- The site will be managed on a long-term basis for the treatment of water, maintenance, and environmental monitoring.

A final site use plan has not yet been developed for the Tar Ponds site and is not part of this project. In the interim and following remediation, the site will be covered with a grading layer of native silty/clayey soils. The purpose of this layer will be to provide additional protection against direct contact by receptors with contaminated soils and to allow for revegetation. The use of silty/clayey soils will also serve to reduce infiltration of precipitation into the subsurface areas.

3.3.5 Long-term Monitoring and Maintenance

A long-term monitoring and maintenance plan will be developed for the Tar Ponds site and will include all facilities, engineered structures, containment structures, and contaminant exposure control systems that require long-term operation subsequent to the completion of the remediation activities. The primary objective of the monitoring and maintenance plan will be to ensure their effective operation and long-term integrity in terms of their desired goals and objectives.

In addition to the structures and containment systems monitoring, sampling of air, surface water, sediment, groundwater, and biota will also be carried out on a periodic basis. Such monitoring programs will serve to provide verification of the effectiveness of the containment structures and contaminant exposure control systems as well, as to permit the detection of any system failures.

The duration of the monitoring will be determined in association with the regulatory authorities.

3.4 OFF-SITE RESOURCE REQUIREMENTS

3.4.1 Land Use

The incinerator will be located off-site (see Appendix B). The site will need transportation access and utilities such as water and electricity.

Licensed borrow pits will be used for the supply of earth fill materials for capping of the Tar Ponds. These will be located during the design stage.

Designated haul routes will be assigned for truck traffic operating to and from the incinerator and the borrow pits to minimize disturbance through residential areas.

3.4.2 Resources/Materials

A partial list is provided below of the resources and materials that will be used during remediation:

- Potable water from the Municipality will be used for showers, lunchrooms, and washrooms at each site. Water will also be used for decontamination of trucks leaving the site at the wash pad, and incinerator cooling.
- A connection to the municipal sewer will be required for sewage from non-contaminated areas of the site such as washrooms and lunchrooms.

- One or more laboratories will be used to provide analytical testing services. These will include local or on-site facilities for routine testing and more specialized facilities for non-routine testing.
- Granular materials such as slag, gravel and rip rap will be used for access road and capping.
- A solidification/stabilization binding agent additive such as Portland cement will be used in the solidification of Tar Pond sediments.
- Clay and bentonite will be used as sealing material in containment of contaminated materials.
- Geomembranes and geotextiles will be used to prevent erosion and to prevent cross contamination of materials.
- Piping might be used for well casings and for management of surface and groundwater.
- Fill, topsoil, plantings will be used as part of the final site restoration and landscaping.
- Fuel will be used for vehicles and equipment that will be dedicated to the contaminated areas of the site.
- Sheet piling will be used for support of excavations and fill materials and vertical cut-off walls.
- Power will be used at all sites.

3.4.3 Waste Disposal

Waste generation and off-site disposal of wastes will be minimized where feasible. The anticipated waste streams and proposed methods of disposal are as follows:

- Debris currently on-site, that is practical to salvage, such as scrap metal, will be decontaminated and removed from site for recycling. Such materials will be tested to confirm that they are safe for removal. Other debris will be buried on-site and covered.
- Non-hazardous domestic wastes (administration, lunch room, etc.) will be sent to the local licensed municipal facility.
- A connection to the municipal sewer will be required for sewage from non-contaminated areas of the site such as washrooms and lunch rooms.
- Contaminated combustible materials that are generated during the cleanup, such as personal protective equipment and carbon from the water treatment plant, will be directed to the incinerator for destruction. Such materials generated during periods when the incinerator is not operating will be decontaminated, if possible, and removed from site and transferred to a waste facility licensed to accept them.
- Contaminated non-combustible materials, such as old bricks, concrete, piping, reinforcement steel, and other residual infrastructure materials will be retained and buried on-site.
- Sanitary sewage from washrooms and food processing areas will be disposed to the municipal system. Wastewater from showers and washbasins in the personnel decontamination area will be treated in the on-site water treatment plant.

- Maintenance wastes, such as oils and filters from excavating equipment that are generated on the contaminated site, will be shipped to the incinerator for use as supplemental fuel.

3.5 SCHEDULE

The proposed schedule for completing the various stages of the remediation is as follows:

Activity	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Design Engineering	▨	▨	▨							
Environmental Assessment	▨	▨	▨							
Eliminate PCBs			▨	▨	▨	▨	▨			
Remediate & Cap Tar Ponds			▨	▨	▨	▨	▨	▨	▨	▨
Decommission Facilities										▨

4.0 PROPOSED REMEDIATION OF THE COKE OVENS

This section of the Project Description report focuses exclusively on the Coke Ovens site remediation. Included in this section is a description of the overall remediation activities, including pre- and post-remediation activities that will be performed, off-site resource requirements, and schedule.

The Coke Ovens site is approximately 68 ha in area, bounded by the residential area of Whitney Pier to the north, the SYSCO property to the west, the Municipal Ash/Industrial Disposal (MAID) site to the east, and the Ashby residential area to the south. The Coke Ovens site is transected by Coke Ovens Brook, which enters the site from the east and makes its way westward across the site and south of the SYSCO property where it discharges into the South Tar Pond. The corridor between the Coke Ovens site and the South Tar Pond that contains Coke Ovens Brook comprises approximately 4.1 ha. This corridor is referred to as the Coke Ovens Brook Connector and is included as part of the Coke Ovens site.

The Coke Ovens site contained a coke production facility for almost 100 years (closed in 1988) that provided raw carbon feedstock and fuel for a nearby steel mill. Other industrial facilities were located on the site and used by-products of the coking operations in the manufacture of commercial goods and products. An estimated 560,000 tonnes (280,000 m^3) of soil on the Coke Ovens site is contaminated with, primarily, petroleum hydrocarbons, PAHs, and metals. An additional 1,300 tonnes (1,000 m^3) of PAH contaminated sediment is present in Coke Ovens Brook and 25,000 (12,500 m^3) tonnes of contaminated soil is present in the In-ground Tar Cell.

The site will be remediated using a variety of techniques to prevent any further off-site contaminant migration and future risk of exposure to the community and the environment. The remediation activities to take place at the Coke Ovens site are summarized in Table 4.1.

TABLE 4.1 Proposed Remediation Program – Coke Ovens

Activity		Description
1.	Control Water	Reroute groundwater and surface water flowing through the site to minimize water contact with contaminants.
2.	Remove and Destroy Selected Contaminants	Excavate 1,300 tonnes (1,000 m^3) of PAH contaminated sediment from Coke Ovens Brook and 25,000 tonnes (12,500 m^3) of PAH contaminated material from the in-ground Tar Cell and destroy the excavated material in an approved temporary incinerator that will be constructed offsite in Industrial Cape Breton.
3.	Landfarm Selected Surface Soil Contamination	Treat, in-place, 253,700 tonnes (128,800 m^3) of the remaining contaminated surface soils using bioremediation. Landfarming of the top 0.5 m of contaminated soil will be used to promote biological breakdown of contaminants in surface soils.
4.	Contain Residual Contaminants	Install a containment system designed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability vertical walls installed at various locations around the perimeter of the Coke Ovens site and a soil cover designed to facilitate future site use(s).
5.	Site Surface Restoration and Landscaping	Site restoration and landscaping will be compatible with the natural surroundings and future use.
6.	Long-term Monitoring and Maintenance	Monitor air quality, water quality, soil and the performance of the containment system after completion of the project.

The features of the site, the location of selected contaminated areas, and proposed remedial activities, are provided in Figure 4.1. Cross sections of the Coke Ovens showing the locations of the contaminated materials are shown in Figure 4.2.

Generally, the remediation requires 2 steps: 1) removal and/or treatment of contaminants followed by 2) containment of residuals in-place.

To facilitate removal of the contaminants, groundwater and surface water controls will be implemented on the site. These controls will include rerouting of brooks on the site and installation of vertical groundwater cut-off walls near the perimeter of the site. Contaminated groundwater will be pumped to a water treatment facility prior to discharge.

Approximately 26,300 tonnes (13,500 m^3) of PAH material from Coke Ovens Brook and the In-ground Tar Cell will be excavated and safely destroyed in a temporary, fully approved incinerator located off site. This incinerator will be located on a site (see Appendix B) that has been carefully selected in accordance with strict regulatory requirements. It will be operated, maintained and monitored in accordance with the regulatory requirements and accepted operational practices. Selected remaining soils on the Coke Ovens site, contaminated with hydrocarbons, will then be bioremediated. The site will then be capped with soil to contain any further migration of contaminants and reduce the risk of exposure to both the community and environment.

Further details are provided in subsequent sections.

4.1 PRE-REMEDIATION ACTIVITIES

The following information describes activities that will be completed prior to physically beginning the remediation of the Coke Ovens.

4.1.1 Environmental Management Plan

An EMP for remediation of the Coke Ovens is included as Appendix C. Mitigative measures identified during the EA process will be incorporated into the EMP.

4.1.2 Health and Safety Plan

A HASP will be developed for the site that will cover all phases and elements of the remediation project. The HASP will be developed by a health and safety professional to ensure adequate precautions are taken for the protection of workers and the general public. It will include a worker-monitoring program including medical checks before, during, and after completion of the work. The Plan will be modified over the life of the project as new information becomes available for improved worker protection. The objectives of the plan will be to:

- define activities which are likely to represent risks to worker safety and health, requiring planning, design, inspection or supervision by an engineer, competent person (as defined by regulations) or other professional;
- provide guidelines for completing a project health and safety analysis at initiation and at critical stages of the project;
- establish a decision-making process to identify worker and public protection measures;
- establish supervisor and employee training requirements according to the project plan including recognition, reporting and avoidance of hazards, and knowledge of applicable Standards and the project-specific HASP;

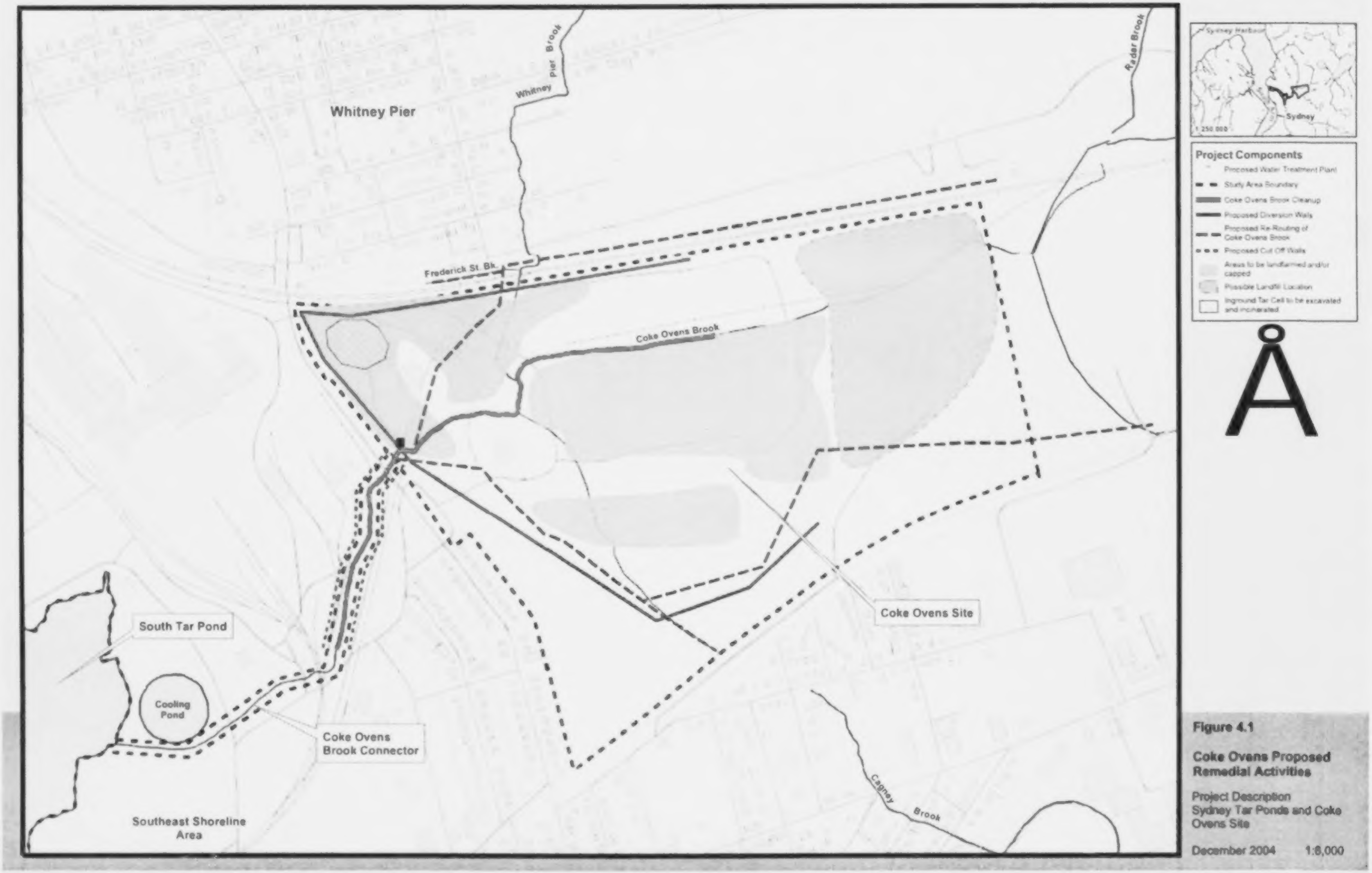
Whitney Pier
Whitney Pier Brook
Rader Brook
Frederick St. Bk.
Coke Ovens Brook
Coke Ovens Site
South Tar Pond
Cooling Pond
Coke Ovens Brook Connector
Southeast Shoreline Area
Cagney Brook
Sydney Harbour
Sydney
1:250 000
Project Components
Proposed Water Treatment Plant
Study Area Boundary
Coke Ovens Brook Cleanup
Proposed Diversion Walls
Proposed Re-Routing of Coke Ovens Brook
Proposed Cut Off Walls
Areas to be landfarmed and/or capped
Possible Landfill Location
Inground Tar Cell to be excavated and incinerated

Figure 4.1

Coke Ovens Proposed Remedial Activities

Project Description
Sydney Tar Ponds and Coke Ovens Site

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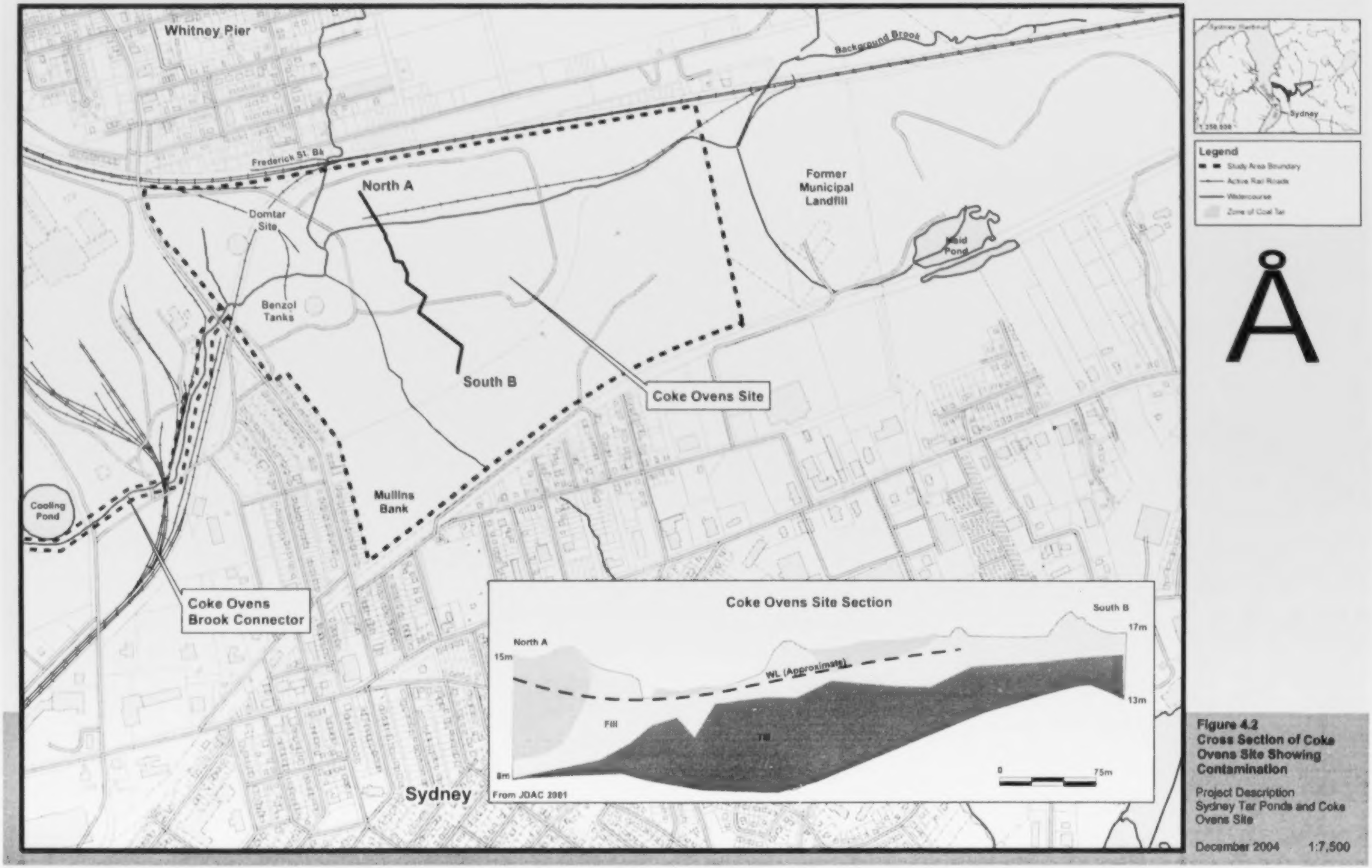
Whitney Pier
Frederick St. Bk
Background Brook
Former Municipal Landfill
Maid Pond
North A
South B
Domtar Site
Benzol Tanks
Coke Ovens Site
Mullins Bank
Cooling Pond
Coke Ovens Brook Connector
Sydney
Coke Ovens Site Section
North A
South B
15m
17m
13m
8m
WL (Approximate)
Fill
Till
0
75m
From JDAC 2001
Sydney Harbour
Sydney
1:250 000
Legend
Study Area Boundary
Active Rail Roads
Watercourse
Zone of Coal Tar

Figure 4.2
Cross Section of Coke Ovens Site Showing Contamination

Project Description
Sydney Tar Ponds and Coke Ovens Site

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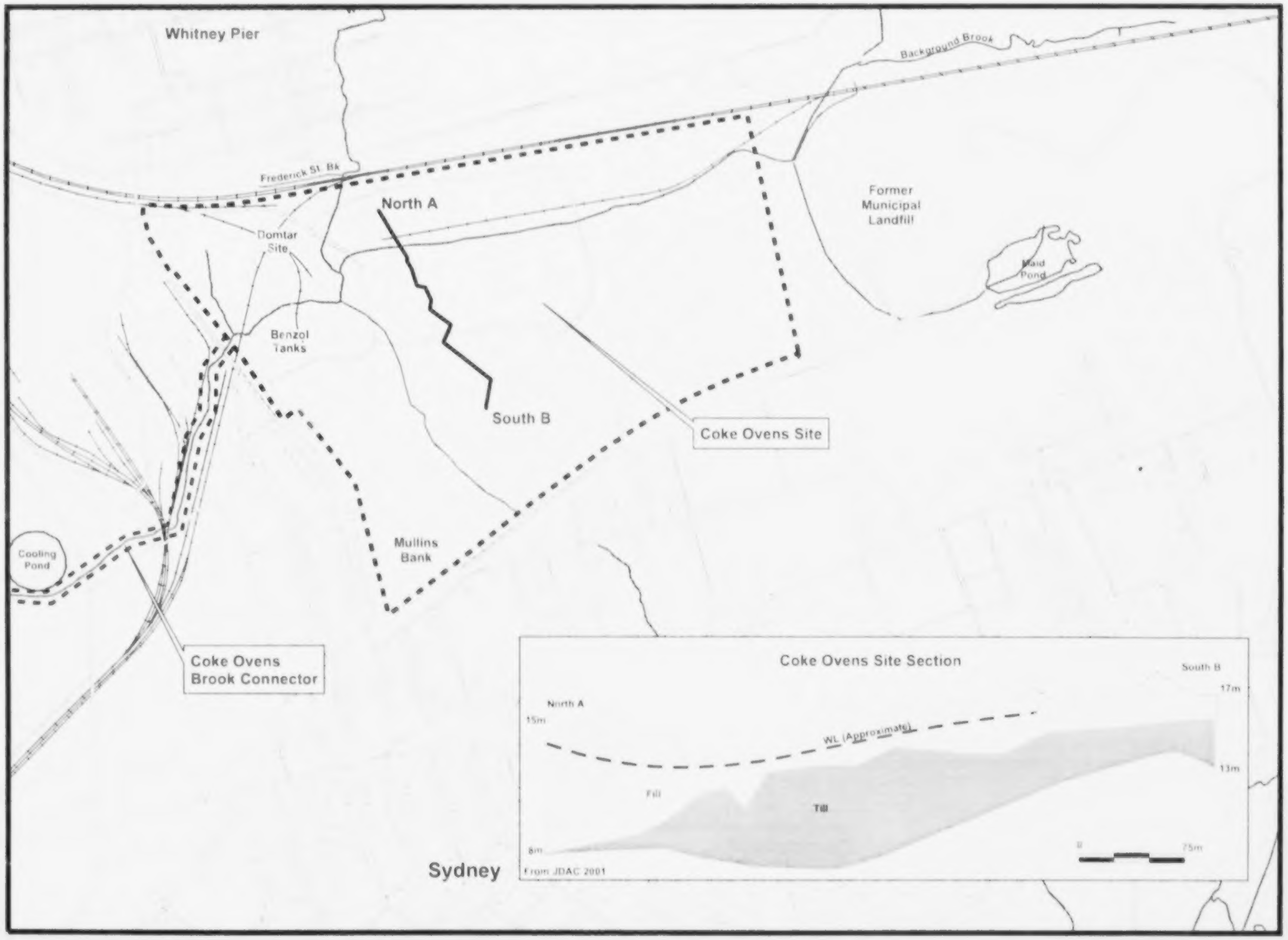
Whitney Pier
Background Brook
Frederick St. Bk
North A
Domtar Site
Former Municipal Landfill
Maid Pond
Benzol Tanks
South B
Coke Ovens Site
Mullins Bank
Cooling Pond
Coke Ovens Brook Connector
Sydney
Coke Ovens Site Section
North A
South B
15m
17m
13m
8m
WL (Approximate)
Fill
Till
0
75m
From JDAC 2001
Sydney
Legend
Study Area Boundary
Active Rail Route
Watercourse

Figure 4.2
Cross Section of Coke Ovens Site Showing Contamination

Project Description
Sydney Tar Ponds and Coke Ovens Site

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- provide general guidelines for controlling the most commonly identified hazardous operations, such as: cranes, scaffolding, trenches, confined spaces, hot work, explosives, hazardous materials, leading edges, etc.;
- establish processes to ensure that hazards are identified and corrected with preventive measures that are implemented in a timely manner;
- provide a process for reporting near-misses and accidents;
- identify documentation requirements for training, permits, hazard reports, inspections, uncorrected hazards, incidents and near misses;
- establish the need for project-specific emergency response plans;
- define the requirement for a designated competent person responsible for and capable of implementing the program/plan;
- establish a communications plan to provide preventative and emergency information to the general public;
- provide information to the public on guidelines for completing a project health and safety analysis at initiation and at critical stages of the project;
- establish a decision-making process to identify public protection measures; and
- provide public information regarding measures taken to prevent hazards, requirements according to the project plan, reporting and avoidance of hazards, and knowledge of applicable Standards and the project-specific HASP.

Each contractor and consultant retained for the project will be required to submit for review, a Project-specific HASP for its workforce, and will be responsible for its implementation. The HASP will meet the requirements of the Master HASP. Audits will be completed to ensure compliance with the Project-specific HASP.

The Master HASP will identify adequate precautions to be taken for the protection of the general public. It will include a monitoring program and communication plan for providing information to the general public. The Plan will be modified over the life of the project as new information becomes available.

4.1.3 Site Infrastructure

Prior to commencing remediation activities, general site infrastructure will be designed and constructed at the Coke Ovens site. Facilities will be constructed both inside and outside of the contaminated area. These will include:

- Parking lots for employee and visitor vehicles outside of the contaminated areas;
- Storage areas on and off the sites for equipment and supplies;
- Security facilities to control and log the entry and exit of personnel and vehicles to the contaminated sites. The security will be in the clean zone to ensure authorized entry. Vehicles and personnel leaving the site will go through decontamination facilities prior to exiting via the security building;
- Offices, washrooms and lunchrooms outside of the contaminated zone. Personnel will have access to safe, clean facilities for meals and hygiene;

- Decontamination facilities for personnel to leave the contaminated area. This will include a soiled clothing change area, showers, and a street clothes change area. Sufficient storage will be provided for retaining soiled personal protective equipment such as coveralls and gloves prior to disposal. Disposal will be accomplished by incineration (during incinerator operation) or off-site at an approved facility prior to or after the incinerator in operating. Water from showers will be directed to the water treatment plant. Safety equipment that will be re-used will be directed to a designated area and subsequently decontaminated and approved for re-use;
- Buildings for the storage of tools, specific replacement parts, and repair and maintenance of equipment (such as excavators). Once heavy equipment is on the contaminated site, the goal will be to complete routine maintenance on-site; otherwise it will be thoroughly decontaminated before removing from the site. Maintenance and repair personnel will be provided by the contractor and will be required to abide by the HASP as well as be capable of conducting repairs while wearing approved safety equipment;
- Utilities such as potable water, sanitary sewage and electricity. Much of this infrastructure will be installed prior to tendering of specific contracts. Selected contractor(s) will address the service requirements of specific treatment technologies or construction activities. Where possible, below grade installation will be avoided, however, some below grade installation is necessary and will require proper management of any impacted materials encountered;
- Equipment decontamination pads for cleaning equipment (daily, as required) or prior to leaving the site. A decontamination pad currently exists for the Coke Ovens site and this facility will be evaluated during the design stage to confirm that it is adequate; and
- One or more isolation pads to retain materials prior to them leaving the site. The pads will allow materials or equipment to be quarantined until sample test results confirm that they can safely be removed from site. The isolation pads will be self-contained to include the control of impacted water, dust, and odour.

4.1.4 Water Treatment Plant

Water treatment will be required to handle contaminated water pumped from the Coke Ovens site. Treatment will be required to ensure 1) that liquid effluent discharges are in compliance with the pollution prevention provisions of the *Fisheries Act* and 2) discharges will not cause an exceedance of the receiving environment water quality objectives.

It is assumed that wastewater will need to meet, at a minimum, the acute lethality test (*Fisheries Act*) and should not cause chronic effects. If discharged to a municipal sewer leading to a treatment plant, the wastewater will meet the appropriate sewer discharge standards. It is anticipated that specific discharge standards will be developed in conjunction with the appropriate regulatory agencies prior to the start-up of the remediation project. Sampling and analysis will be conducted to ensure any required discharge criteria are met.

Pumping of contaminated groundwater from the Coke Ovens will generate up to 1,500,000 m^3/year of wastewater (Dillon, 2004). Contaminants in the groundwater requiring treatment include petroleum hydrocarbons, PAHs, and metals. The parameters to be monitored in the effluent will be prescribed by the relevant regulatory authorities.

The feasibility of having a single treatment plant to handle both the Tar Ponds and Coke Ovens sites or having independent treatment plants for each site will be determined during the engineering design stage. A water treatment plant will be a long-term fixture for treatment of contaminated groundwater at the Coke Ovens site and this will be a factor in the decision. Advantages of having a single plant are reduced capital and operating costs. These costs could be offset by the increased pipeline or transportation requirements between sites. Water treatment facilities are currently available on the SYSCO site, and those facilities will be evaluated in the design phase to determine if they can be used in conjunction with additional treatment units.

Water treatment systems for this purpose can be purchased from suppliers as a series of prefabricated process units that are installed on a concrete pad. The treatment process typically consists of the following basic steps:

- Equalization using a tank or series of tanks to minimize flow variations and to isolate different wastewater streams;
- Batch treatment depending on the contaminant of concern that requires removal from the wastewater;
- Gravity settling for suspended solids removal. Floating oil will be removed for destruction in the incinerator (during incinerator operation) or disposed of through a local licensed contractor;
- Biological treatment to oxidize much of the soluble organics followed by gravity settling or filtration to remove the biological solids;
- Polishing of effluent using sand filters, micron bag filters, and activated carbon to remove dissolved organics prior to discharge; and
- Use of large aboveground storage tanks for the containment of treated effluent while awaiting analysis. Release of effluent will be permitted only upon receipt of acceptable analytical results and only when a release form has been properly completed and the appropriate signatures affixed.

Once a fully approved treatment plant(s) have been installed, direct discharge will take place.

4.2 REMEDIATION ACTIVITIES

4.2.1 Control Groundwater and Surface Water

Surface waters at the Coke Ovens site are collected in Coke Ovens Brook. Coke Ovens Brook traverses the site from east to west and empties into Sydney Harbour *via* the South and North Tar Ponds. Shallow groundwater from the immediate area also discharges to these surface water features. The continued discharge of potentially contaminated surface run-off and groundwater, together with the potential for high flow conditions during peak storm events, could create difficult, and on occasion, hazardous working conditions during soil excavation and/or remediation.

To address the surface water and groundwater concerns, one of the first steps will be to redirect surface water flows and outfalls to newly constructed channels. When surface water and groundwater controls are required, they will be used to:

- minimize the overall water treatment requirements;
- facilitate access to specific areas requiring remediation;
- mitigate potential impacts to receiving water bodies;
- mitigate potential exposures to on-site and off-site receptors; and
- prevent recontamination of the remediated areas.

These controls will be implemented before, during, and after the remediation project.

New watercourse channels will be located and designed to move surface water flows away from the areas of contaminated soils and sediments, thereby isolating the water from the site contaminants. The new channels will also enable access to the existing channels to remove contaminated fills and sediments, to reduce the potential for hazard generation during the remedial process. The realignment of Coke Ovens Brook, noted in Section 1.9 as a proposed preventative activity, will assist in meeting these objectives. While Coke Ovens Brook is the primary watercourse through the Coke Ovens site, the tributary flows of Domtar, Whitney Pier and Cagney Brooks will also be addressed (see Figure 4.1).

The potential flow of groundwater into the work areas from upgradient locations will be addressed through the installation of a series of vertical barrier walls and/or diversion trenches (see Figure 4.1 and Section 4.2.4).

Dissolved phase PAHs in groundwater are identified as a potential mechanism for recontaminating sediments in Domtar Brook and Coke Ovens Brook, within the Domtar area (CRA, 2002a). The rerouting of watercourses and the installation of downgradient subsurface vertical barriers will reduce the potential for any future migration of the coal tar into Coke Ovens Brook.

The management of the dissolved phase contamination in the groundwater will require use of a pump-and-treat process during and subsequent to the remediation activities. The pump-and-treat system will include a combination of wells and interceptor trenches. These will be effective at collecting both contaminated groundwater and mobile coal tar. It is likely that the groundwater collection pipes will be laid in the existing Coke Ovens Brook and Domtar Brook Underdrain alignments within the Domtar site.

4.2.2 Remove and Destroy Selected Contaminants

4.2.2.1 Remove Coke Ovens Brook Sediments

One thousand three hundred tonnes (1,300 Te) of PAH contaminated sediments along Coke Ovens Brook and the Coke Ovens Brook Connector will be excavated using standard equipment such as excavators and backhoes. The contaminated sediments are limited to a distinct zone of recently deposited sediments overlying the native organic clays and glacial tills. Surface water through this work area will be redirected during remediation activities, and contaminated sediments in the Brook will be excavated and transported to the incinerator for destruction.

4.2.2.2 Remove Contents of In-ground Tar Cell

Twenty-five thousand tonnes (25,000 Te) of PAH contaminated soil in the In-ground Tar Cell will be excavated to a maximum depth of approximately 2 m below ground surface using standard equipment such as excavators and backhoes. To ensure there are no releases of harmful emissions, control measures will be implemented during this operation. The details of this component will be determined as part of the detailed engineering design phase.

4.2.2.3 Transport Contaminated Materials To Incinerator

All contaminated materials removed from the Tar Cell and Coke Ovens Brook and identified for incineration (see Section 5.0) will be transported by truck or railcar to the off-site incinerator where they will be prepared for incineration and then destroyed. The final method of transport will be determined based on an assessment of numerous factors, including the distance to the incinerator site and available facilities such as rail lines and access roads.

4.2.3 Landfarm Selected Surface Soil Contamination

Bioremediation using landfarming will be used over a period of 1 to 3 years to remediate the top 0.3 to 0.5 m of hydrocarbon-contaminated soil at selected areas on the Coke Ovens site. An estimated 253,700 tonnes (128,800 m^3 at 0.5 m thickness) will be bioremediated (see Figure 4.1).

Bioremediation is commonly used to treat low-level coal tar and creosote impacted materials and is accepted as an effective method for remediating PAH contaminated wood treating sites (USEPA, 1995). Landfarming is not expected to be effective at remediating hardened coal tar.

Generally, bioremediation uses microorganisms naturally occurring in the soil to destroy selected organic contaminants in soil, sediment, or groundwater. Simply put, the microorganisms metabolize (i.e., consume) the contaminants in the soil. The breakdown of organic contaminants by microorganisms depends upon a number of factors including the type and concentration of contaminant, the characteristics of the contaminated materials (moisture, pH, permeability, uniformity), process conditions (oxygen supply, nutrient availability, toxins), and climate conditions (predominantly temperature).

Activities that will be completed prior to landfarming include: clearing; grubbing; grading; construction of berms for surface water control; placement of liners for treatment cells and/or storage ponds (if necessary); leachate collection and treatment systems; soil pretreatment methods (e.g., shredding, blending and amendments for fluffing, pH control); and enclosures and appropriate vapor treatment facilities (where needed). Surface water management systems will be necessary to avoid saturation of the treatment area or washout of the soils in the landfarm.

Initial site preparation will include the removal of residual surface debris including scrap construction materials (e.g., steel, concrete), and miscellaneous surface debris such as refractory bricks, coal, coke, etc. The surface soils will then be grubbed to remove any vegetation. Clearance of other obstacles and encumbrances such as structural foundations and buried piping will be completed both prior to and during the initial soil tilling operations. Debris currently on-site that is practical to salvage, such as large pieces of scrap metal, will be decontaminated and removed from site for recycling. Such materials will be tested to confirm that they are safe for removal from the site. Other debris will be buried on-site and covered or disposed at a secure landfill.

Areas will be designated on the site for equipment storage and staging and mixing areas for nutrient and amendment solutions. These solutions can be applied using portable equipment such as a water truck and water cannon.

During landfarming, the top 0.3 m to 0.5 m of the soil at selected contaminated areas will be tilled, nutrients will be added, and adjustments will be made to the moisture content and pH to enhance the biological degradation (reduction in hydrocarbon concentration) of the contaminants. The addition of nutrients and soil adjustments will be made through the application of liquid and/or solid amendments to the surface soils. Soil tilling will be used to mix the nutrients and other amendments into the soil as well as to aerate the soil and provide the necessary oxygen requirements to enhance the biological degradation. The tilling operations will be carried out using conventional equipment such as a tine tiller, disc harrow, or claw ripper. Performance monitoring will be undertaken throughout the landfarm operation to evaluate remedial performance, to identify ongoing nutrient/amendment requirements and application rates and frequencies, and to determine successful achievement of the desired remedial goals.

Odours and vapours could be generated during landfarming. Vapours from the landfarm will be monitored during operation for compliance with appropriate permits or regulatory limits on atmospheric discharges. If required, appropriate vapor treatment technology will be specified, including operation and monitoring parameters. If the design indicates that odours will be a concern, the landfarming approach might also be altered to reduce the movement of soil, hence eliminating or reducing vapours and dust. While nuisance odours could be a site-wide issue, chemical air emissions are not expected to be a significant concern, due largely to the relatively low levels of volatile contaminant concentrations to be found in the upper 0.5 m of the site soils. Most of the coal tars at the Coke Ovens site were produced in processes that limited benzene to relatively low concentrations. Two exceptions were the Benzol Plant and Byproducts Building areas, which could be expected to contain high concentrations of benzene.

Control of soil erosion from wind or water will be achieved by terracing the soils into windrows, constructing water management systems (e.g., berms and ditches), and water spraying to minimize dust.

Appropriate provincial and/or federal approvals and permits for the construction and operation of a bioremediation treatment facility will be obtained prior to implementation. Provincial approvals will include those required under Section 66 of the Environment Act - Activities Designation Regulations. Although not specifically referenced, there are a number of different categories which bioremediation might fall under including: Division IV - Dangerous Goods/waste dangerous goods/salvage yard approvals (handling of petroleum contaminated wastes); Division V - Part 11: Biotechnology (construction, operation, reclamation of a biotechnology products manufacturing plant); and Division VI - Other Approvals. Other approvals are likely to include those for operation of a waste treatment facility (Industrial Waste Permit), stormwater management, and atmospheric emissions. Once the activity has been classified the process of obtaining an approval then follows the Approval Regulations under the Environment Act for submission to Nova Scotia Department of Environment and Labour.

The *New Substance Notification Regulations* under the *CEPA*, 1999 require that notification be sent to Environment Canada prior to the import or manufacture of any microorganism not listed on the Domestic Substances List. Environment Canada and Health Canada will jointly assess any potential for adverse effects of the microorganism on human health and the environment.

4.2.4 Contain Residual Contaminants

Residual contaminants at the Coke Ovens site will be isolated using a containment system designed to reduce the possibility of human and ecological exposure to the contaminants as well as to prevent the movement of the contaminants off-site. In-place containment will involve the construction and placement of barriers that block the pathway between the contaminant source and the receptor. The barriers will be designed to remain in-place permanently.

Containment technologies effectively manage exposure risks, can be implemented in a timely manner, and are generally economical. Containment technologies have been selected as appropriate technologies to mitigate construction related vapour and odour issues at other coal tar sites (CBCL Limited / ENSR International, 2003a).

At the Coke Ovens site, the containment system will consist of low permeability vertical walls installed at various locations around the perimeter of the site designed to prevent horizontal groundwater flow and associated contaminant migration. This includes preventing off-site groundwater from flowing onto the site and potentially contacting contained contaminants, as well as preventing the flow of groundwater and aqueous phase liquids (e.g., coal tar) off of the site.

A soil cover will be placed over the site and designed to facilitate future site uses. This cover will also prevent impacted soil from plowing off-site, control water erosion of contaminated soil, and prevent exposure to human and ecological receptors.

4.2.4.1 Vertical Cut-off Wall Installation

Vertical cut-off walls (see Figure 4.1) will be used on the Coke Ovens site to control the movement of clean and contaminated groundwater and contaminants. Different designs, monitoring programs, and performance criteria will be used at different areas of the site depending on the objectives for the vertical cut off walls. For example:

- Cut off walls north and south of the Coke Ovens will be installed to prevent the influx of clean groundwater;
- Cut off walls west of the Coke Ovens will be installed to prevent the movement of contaminants to SYSCO to the west; and
- Cut off walls on Coke Ovens Brook will be installed to prevent the movement of coal tar from SYSCO into the Brook.

Vertical cutoff walls may be constructed of materials such as:

- Sheetpile, which is available as vinyl or steel and will be driven from the surface to the final depth. Alternatively, depending on depth, the sheetpile can be placed in an excavated trench and backfilled. The sheetpile and clean backfill will be imported to the site.

- Bentonite or cement walls, which are typically excavated, mixed, and backfilled with bentonite or cement. The equipment used is similar to conventional earth moving construction equipment (e.g., dozers, excavators). The bentonite, and possibly backfill, will be brought onto the site.
- Low permeability soil, where the depth to the confining layer is suitably shallow. Conventional earth moving equipment will be used to excavate a trench and backfill it with low permeability soil (e.g., clay). Clean low permeability soil will be imported to the site.
- A geomembrane or a geosynthetic clay liner could also be used as a vertical cutoff wall. In this case, an open trench will be excavated, the geomembrane or geosynthetic clay liner will be placed along the wall of the trench and the trench will be backfilled. The geomembrane or geosynthetic clay liner and clean backfill will be imported to the site.

The selection of appropriate construction methods will be based on design criteria such as depth of impact, depth to groundwater, soil type, etc. A rigorous construction quality assurance program will be established throughout any or all methods of construction.

In addition, a monitoring program to confirm the performance will be developed. Performance objectives will include limiting contaminant migration and migration of water onto the site.

4.2.4.2 Surface Cap

Following the excavation and bioremediation of the contaminated material, the surface of the Coke Ovens site will be capped with a grading layer of native silty/clayey soils. A clean soil cover 0.3 m deep will be applied over the site.

The purpose of this layer will be to provide additional protection against direct contact by receptors with contaminated soils and to allow for temporary or permanent revegetation. The use of silty/clayey soils will also serve to reduce infiltration of precipitation into the subsurface areas so that less groundwater will require management through pump-and-treat. The cap will be graded to promote runoff and reduce infiltration.

Conventional earth moving equipment such as dozers, compactors, smooth drum rollers, excavators, dump trucks, water trucks, and scrapers will be used.

Rigorous construction quality assurance and quality control procedures will be developed during the design process and will be implemented during construction. In addition, a monitoring plan to confirm the long-term performance will be developed.

4.2.5 Monitoring

Various monitoring programs will be implemented during the remediation project, several of which are mentioned below. Detailed environmental and health and safety monitoring programs will be developed prior to beginning the remediation activities.

- Soil: Removal and treatment of contaminated soil identified during previous site assessment activities will be the primary focus of cleanup activities. Existing data and reports will be reviewed to provide estimates for the amount of contaminated soil requiring various treatments and to identify where further sampling (if any) will be required to fully and accurately delineate volumes of contaminated soil. Sampling and analyses of soil will be conducted as needed during and after site excavation, but prior to backfilling and capping, to assess the completeness and effectiveness of procedures.

- Air, Groundwater, Surface Water: Monitoring of air, groundwater, and surface water during remedial activities at the Coke Ovens site will be conducted on a regular basis as part of the ongoing monitoring program.
- Employee H&S Monitoring: Employee Health and Safety will be conducted as per the Master Health and Safety Plan developed for the site (see Section 4.1.2).

4.3 POST- REMEDIATION ACTIVITIES

4.3.1 Equipment Removal and Decontamination

In cases where contaminated equipment or buildings are to be re-used, contamination will be removed by various decontamination methods. If the incinerator is operating, it may be more cost effective to simply send the item for incineration, especially if experience indicates difficulty in decontamination.

Specific surface decontamination criteria will be identified. Swab samples of the surfaces of decontaminated equipment will be collected and analysed prior to release from the site or reuse in a clean area. Surfaces not meeting the decontamination level will be recleaned.

A formal Release Form with appropriate signatures will document this process and decontaminated equipment will be safely and confidently released from the site or reused.

4.3.2 Removal of Site Facilities

At the end of the cleanup program the facilities used for the remediation will be removed.

- Building and Structures: Buildings and structures that have the potential for contamination will be cleaned prior to demolition. Swab samples will be taken over the surface areas to confirm that they meet site decontamination criteria. Scrap materials will be salvaged where possible and the remaining debris will be disposed at a licensed facility. Where decontamination is impossible or impractical, the materials will be transported to a hazardous waste facility.
- Parking Lots, Equipment and Materials Storage Areas: Gravel, paving, or concrete from these areas will be removed and the ground surface will be restored with vegetation.
- Maintenance and Repair Areas: These will be decontaminated and removed from the site. Swab samples will be taken to confirm the method of disposal.
- Security: Entry and Exits: Security kiosks and facilities will be removed and reused where possible. Fencing that is not used in the future redevelopment will be removed and recycled.
- Municipal Services (Power, Potable Water, Sewage): Buried utilities on contaminated areas of the site will be left in-place at the end of the cleanup but will be disconnected and capped. Utilities installed in non-contaminated areas of the site will be removed unless there is a need to retain them in the redevelopment.

- Decontamination Facilities (Personnel and Equipment): These facilities will be decontaminated and removed from site.
- Offices, Washrooms, Lunchrooms: These facilities will be removed from site unless they will be utilized in the redevelopment.

4.3.3 Removal of Hazardous Materials

Any hazardous materials that cannot be incinerated (such as where the incinerator is not approved to deal with the hazardous material or the incinerator has been shut down) will be managed and disposed of on-site in an approved manner. Ideally, the opportunity for this to occur will be minimized as much as possible and full advantage will be made of the operational status of the incinerator as it "burns itself off the site".

4.3.4 Site Surface Restoration and Landscaping

Site restoration and landscaping will be compatible with the natural surroundings and future use. Regardless of the end use, consideration will be given to the following:

- The site will contain contaminants in the subsurface soils under a soil cover.
- The site will be managed on a long-term basis for the treatment of groundwater, maintenance, and environmental monitoring.

A final site use plan has not yet been developed for the Coke Ovens site and is not part of this project. In the interim and following remediation, the site will be covered with a grading layer of native silty/clayey soils. The purpose of this layer will be to provide additional protection against direct contact by receptors with contaminated soils and to allow for revegetation. The use of silty/clayey soils will also serve to reduce infiltration of precipitation into the subsurface areas.

4.3.5 Long-term Monitoring and Maintenance

A long-term monitoring and maintenance plan will be developed for the Coke Ovens site and will include all facilities, engineered structures, containment structures, and contaminant exposure control systems that require long-term operation subsequent to the completion of the remediation activities. The primary objective of the monitoring and maintenance plan will be to ensure their effective operation and long-term integrity in terms of their desired goals and objectives.

In addition to the structures and containment systems monitoring, sampling of soil, air, surface water, sediment, and groundwater will also be carried out on a periodic basis. Such monitoring programs will serve to provide verification of the effectiveness of the containment structures and contaminant exposure control systems as well, as to permit the detection of any system failures.

The duration of the monitoring will be determined in association with the regulatory authorities.

4.4 OFF-SITE RESOURCE REQUIREMENTS

4.4.1 Land Use

The incinerator will be located off-site (see Appendix B). The site will need transportation access and utilities such as water and electricity.

Licensed borrow pits will be used for the supply of earth fill materials for capping of the Coke Ovens sites. These will be located during the design stage.

Designated haul routes will be assigned for truck traffic operating to and from the incinerator and the borrow pits to minimize disturbance through residential areas.

4.4.2 Resources/Materials

A partial list is provided below of the resources and materials that will be used during cleanup and closure:

- Potable water from the Municipality will be used for showers, lunchrooms, and washrooms at each site. Water will also be used for decontamination of trucks leaving the site at the wash pad, and incinerator cooling.
- A connection to the municipal sewer will be required for sewage from non-contaminated areas of the site such as washrooms and lunchrooms.
- The bioremediation process will use nutrients, water, lime for pH adjustment, and potentially microorganisms for accelerated treatment of contaminants.
- One or more laboratories will be used to provide analytical testing services. These will include local or on-site facilities for routine testing and more specialized facilities for non-routine testing.
- Granular materials such as slag, gravel and rip rap will be used for access road and capping.
- Geomembranes and geotextiles will be used to prevent erosion and to prevent cross contamination of materials.
- Piping might be used for well casings and for management of surface and groundwater.
- Fill, topsoil, plantings will be used as part of the final site restoration and landscaping.
- Fuel will be used for vehicles and equipment that will be dedicated to the contaminated areas of the site.
- Sheet piling will be used for support of excavations and fill materials and vertical cut-off walls.
- Power will be used at all sites.

4.4.3 Waste Disposal

Waste generation and off-site disposal of wastes will be minimized where feasible. The anticipated waste streams and proposed methods of disposal are as follows:

- The discharge from the water treatment plant will be retained in storage and tested. Once confirmation has been received that it meets surface water requirements it will be discharged to the realigned Coke Ovens Brook.
- Debris currently on-site, that is practical to salvage, such as scrap metal, will be decontaminated and removed from site for recycling. Such materials will be tested to confirm that they are safe for removal. Other debris will be buried on-site and covered.

- Non-hazardous domestic wastes (administration, lunch room, etc.) will be sent to the local licensed municipal facility.
- A connection to the municipal sewer will be required for sewage from non-contaminated areas of the site such as washrooms and lunch rooms.
- Contaminated combustible materials that are generated during the cleanup, such as personal protective equipment and carbon from the water treatment plant, will be directed to the incinerator for destruction. Such materials generated during periods when the incinerator is not operating will be decontaminated, if possible, and removed from site and transferred to a waste facility licensed to accept them.
- Contaminated non-combustible materials, such as old bricks, concrete, piping, reinforcement steel, and other residual infrastructure materials will be retained and buried on-site.
- Sanitary sewage from washrooms and food processing areas will be disposed to the municipal system. Wastewater from showers and washbasins in the personnel decontamination area will be treated in the on-site water treatment plant.
- Maintenance wastes, such as oils and filters from excavating equipment that are generated on the contaminated site, will be shipped to the incinerator for use as supplemental fuel.

4.5 SCHEDULE

The proposed schedule for completing the various stages of the remediation is as follows:

Activity	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Design Engineering	▨	▨	▨							
Environmental Assessment	▨	▨	▨							
Eliminate Tar Cell and CO Brook Sediments			▨	▨	▨	▨	▨			
Remediate & Cap Coke Ovens			▨	▨	▨	▨	▨	▨	▨	▨
Decommission Facilities										▨

5.0 INCINERATION OF CONTAMINATED MATERIALS

This section of the Project Description report focuses exclusively on the incineration of contaminated materials from the Tar Ponds and Coke Ovens sites.

Contaminated materials removed from the Tar Ponds and Coke Ovens sites will be transported by rail or road to an off-site facility for treatment using a temporary PCB incinerator. The possible locations of the proposed incinerator are shown in Figure 5.1. The process used to select the proposed incinerator sites is described in Appendix B.

The preferred location for the incinerator is the Victoria Junction Wash Plant. The top 3 other acceptable sites are as follows:

- Phalen Mine;
- North Head; and
- Landfill.

The incinerator will be operated in accordance with the following regulations, guidelines, and standards:

- Federal Mobile PCB Treatment and Destruction Regulations (*CEPA*, 1989);
- Guidelines for Mobile Polychlorinated Biphenyl Destruction Facilities (CCME, 1990); and
- Canada-wide Standard for Dioxins and Furans (CCME, 2001).

Contaminated materials to be incinerated include:

- 120,000 tonnes (92,000 m^3) of PCB sediments from the Tar Ponds (*ex situ* volume);
- 1,300 tonnes (1,000 m^3) of PAH sediments from Coke Ovens Brook;
- 25,000 tonnes (12,500 m^3) of PAH soil from the In-ground Tar Cell; and
- Miscellaneous contaminated materials generated during the remediation activities (e.g., coveralls, gloves, oil filters, tires, etc.).

Incineration is the application of high temperatures in an oxidizing environment to destroy contaminants. Incineration generally occurs in a furnace under highly controlled and regulated conditions to ensure that the contaminants are destroyed or reduced to acceptable levels. Incineration is effective in destroying organic contaminants such as PCBs and PAHs and can operate at relatively high input rates for extended periods of time. Incinerators do not destroy most metals, which remain with the noncombustible materials that collect as ash product or are captured and removed in the air pollution control system.

The most widely used incinerator technologies are rotary kiln, fluidized bed reactor, liquid injection combustor, and infrared incinerator. The rotary kiln is the most common incinerator used for the types of materials and contaminants found at the Tar Ponds and Coke Ovens sites.

Each incinerator design has its own specific requirements for parameters such as feed properties, moisture, and particle size that are required for optimal operation and effective destruction. To prevent the release of contaminants during incineration, air pollution control systems are used to collect particulates and treat all exhaust gases prior to discharge.

A minimum contaminant destruction removal efficiency (DRE) of 99.9999% will be required for incineration of sediments containing PCBs (CBCL Limited / ENSR International, 2003a, 2003b). The DRE is a measure of the efficiency of the incinerator for the removal of contaminants from stack gases, in relation to the level of contaminants in the feed material.

5.1 GENERAL DESCRIPTION OF INCINERATORS

An incinerator typically incorporates 5 basic components:

- Solid waste incineration (primary chamber);
- Secondary combustion chamber;
- Waste heat boiler;
- Exhaust stack; and
- Air pollution control system.

The general layout of a typical temporary incinerator is provided in Figure 5.2.

Support infrastructure includes a central control room, material handling conveyors, water treatment units for the boiler and process effluents, a decontamination and shower facility and additional infrastructure (usually mobile trailers) for storage of safety equipment, supplies and small replacement parts and tools.

Solid materials are fed into the primary combustion chamber *via* conveyor or auger and exposed to high temperatures of approximately 800°C and higher for a period of time ranging from 20 to 40 minutes. The gases produced from the volatilization of organics from the solid matrix and from combustion, exit the primary combustion chamber and enter a particulate removal system that removes gross particulate matter. The solid materials and the particulate matter exit the primary combustion chamber as ash. The gases continue to the secondary combustion chamber (SCC) to complete the incineration process.

The air pollution control system is designed to cool and remove acid, dioxins, furans, and particulate from gases that exit the waste heat boiler. The air pollution control system will likely include a baghouse, a scrubber, and/or a cyclone. The selected incineration technology and associated air pollution control system will effectively remove potentially volatile inorganic constituents (particularly mercury, arsenic and selenium) and dioxins and furans.

The entire incineration process is controlled from the nearby control room. With the use of specialized computer programs and software, highly skilled operators in the control room monitor the temperatures, feed rates, residence times, emission limits, and other key parameters. Automatic waste feed shut off controls can be programmed into the system to handle any number of parameters and conditions such as:

- Primary combustion temperature falls below approved level;
- Secondary combustion chamber outlet gas temperature falls below approved level;
- Residence time is less than approved limit;
- Stack oxygen concentrations fail below approved level;
- Loss of negative pressure to the primary combustion chamber;

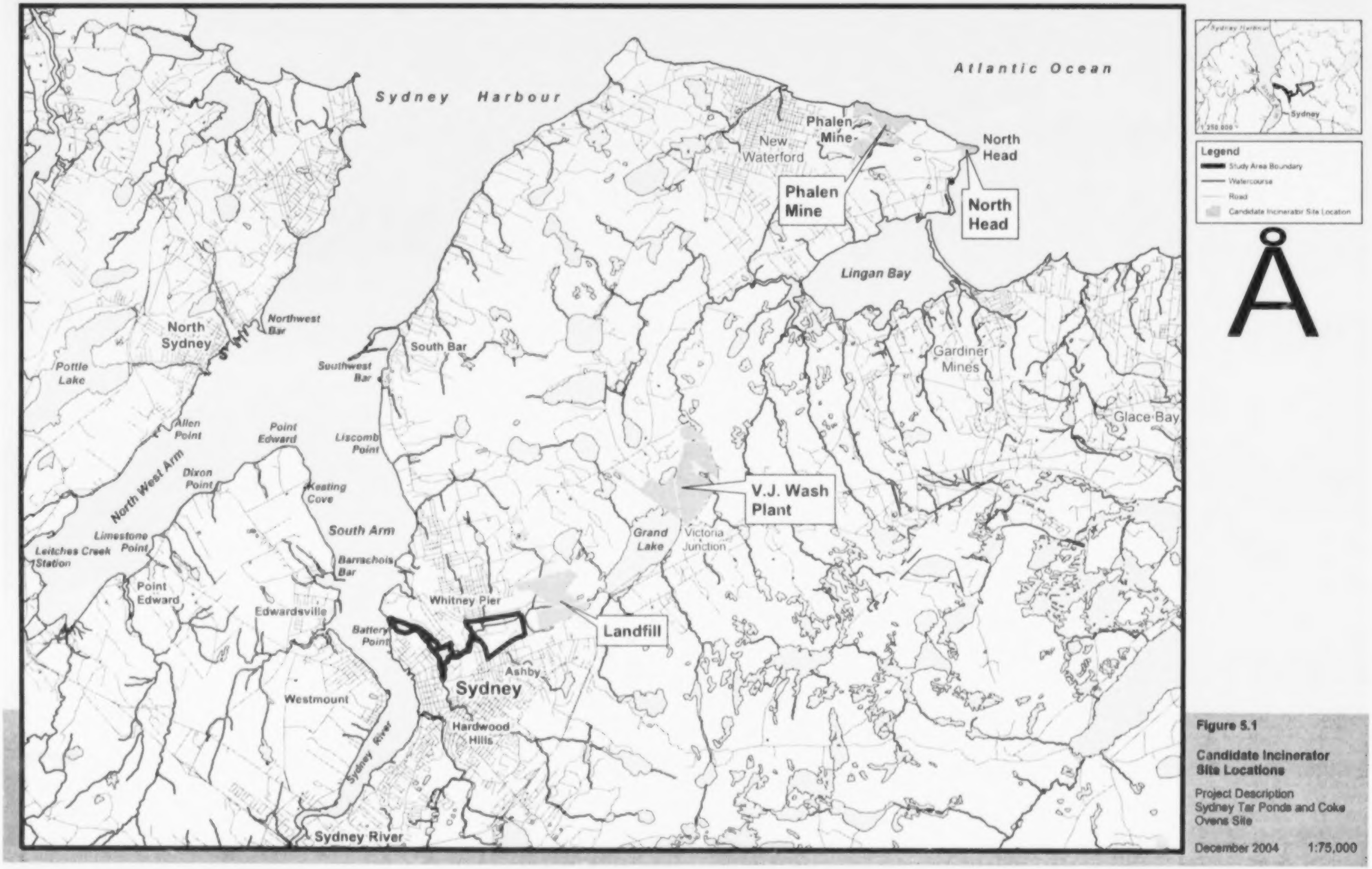
Atlantic Ocean
Sydney Harbour
Sydney Harbour
1:250,000
Sydney
Legend
Study Area Boundary
Watercourse
Road
Candidate Incinerator Site Location
North Head
North Head
Phalen Mine
Phalen Mine
New Waterford
Lingan Bay
Gardiner Mines
Glace Bay
V.J. Wash Plant
Grand Lake
Victoria Junction
Landfill
Whitney Pier
Ashby
Sydney
Hardwood Hills
Sydney River
Sydney River
Westmount
Edwardsville
Battery Point
Barrachois Bar
South Arm
Keating Cove
Liscomb Point
Southwest Bar
South Bar
Northwest Bar
North Sydney
Pottie Lake
Allen Point
Point Edward
Dixon Point
North West Arm
Limestone Point
Leitches Creek Station
Point Edward

Figure 5.1

Candidate Incinerator Site Locations

Project Description
Sydney Tar Ponds and Coke Ovens Site

December 2004 1:75,000

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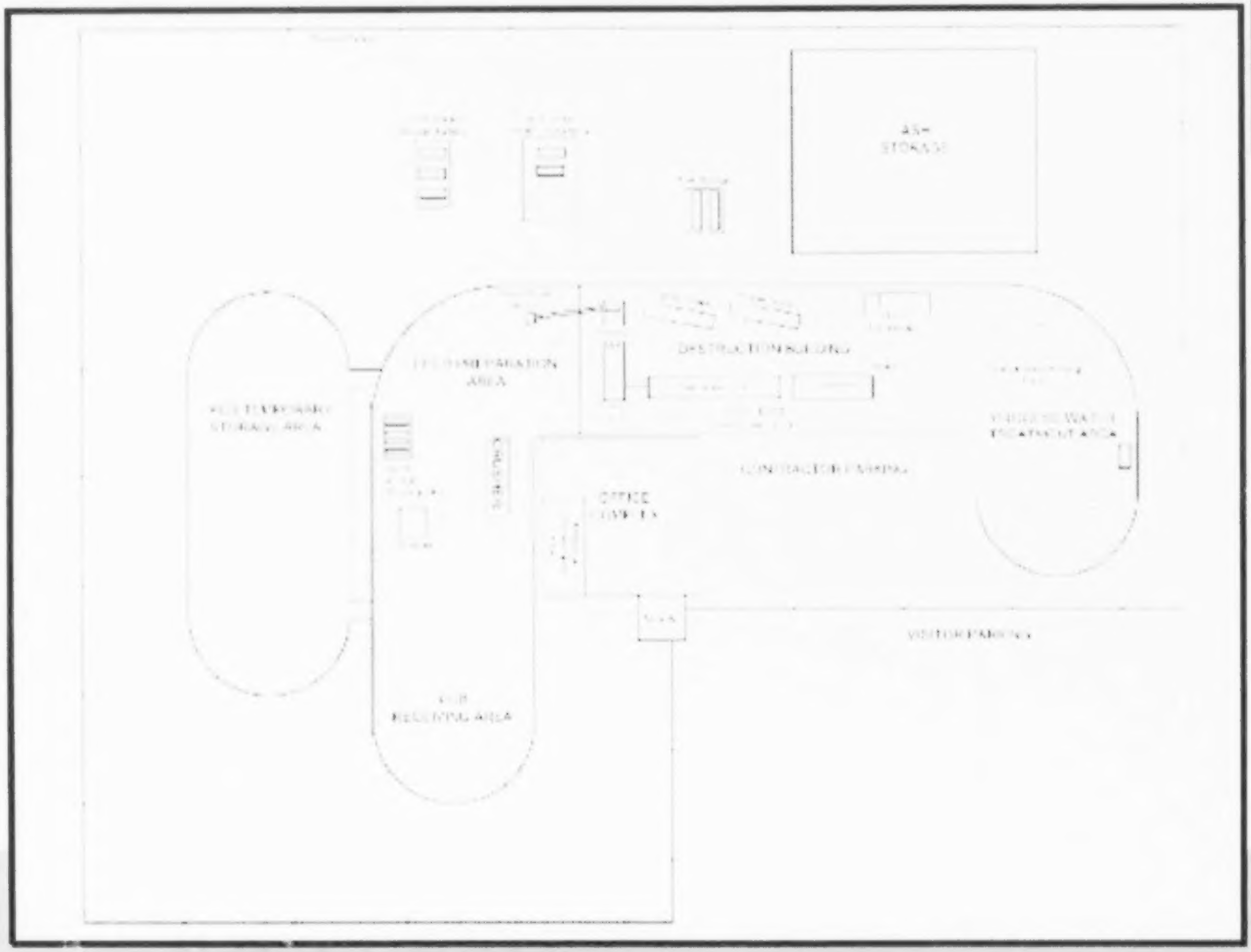
ASH STORAGE
TEMPORARY STORAGE AREA
PREPARATION AREA
CRUSHER
RECEIVING AREA
DESTRUCTION BUILDING
OFFICE COMPLEX
CONTRACTOR PARKING
PROCESS WATER TREATMENT AREA
VISITOR PARKING

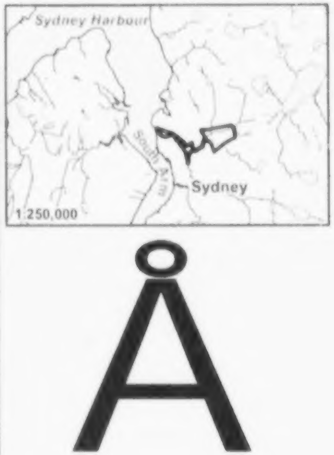
Sydney Harbour
South Arm
Sydney
1:250,000

Figure 5.2

Typical Incinerator Site Layout

Project Description
Sydney Tar Ponds and Coke Ovens Site

December 2004

- Loss of flame or air supply; and
- Failure of the computer software.

When approved operating conditions are not achieved, the waste feed system automatically shut down. During any controlled shutdown the operator(s) will maintain a temperature of greater than 1200 °C in the secondary combustion chamber until normal operating conditions resume or until all treated material has exited the primary combustion chamber (approximately 20 to 40 minutes). This approach ensures destruction of contaminant gases prior to exiting the system.

5.2 PROPOSED INCINERATOR TO BE USED DURING REMEDIATION

The incinerator will be a dedicated, temporary, constructed facility to be used only to incinerate contaminated materials that are a part of or generated during this remediation project. It will have a design capacity of approximately 10 tonnes per hour (dry weight) and operate for 24 hours a day, 7 days a week, for approximately 250 days per year. An area of between 2 and 5 ha will be required for the incinerator and associated ancillary facilities.

The proposed incineration system will likely include the following components:

- Waste material feed preparation area;
- Waste feed system;
- Combustion chamber (primary and secondary);
- Exhaust gas stack;
- Stack gas treatment area to clean stack gases (a scrubber);
- Stack gas particulate capture device;
- Treated material (ash) handling/disposal system; and
- Energy and control systems.

The waste feed area will be housed within a building. As well, there will be other site buildings such as a site safety building, a decontamination facility, a site office, staff lunchroom, a facility control room, and possibly a site services building (i.e., electricity, water, etc.). It is expected that these site buildings will be removed from the site when the project concludes, unless some beneficial, post-project use can be found.

After incineration, the remaining materials will consist of ash, metal, and noncombustible materials. Treated ash that meets acceptance criteria for metals concentrations and leachability will be used as backfill at the Tar Ponds or Coke Ovens sites, or placed in an approved landfill. Treated metal and other noncombustible materials will be buried on the Coke Ovens site or disposed at an approved and licensed waste disposal facility.

5.2.1 Services (Water, Power, Sewer, Access Roads, Security)

The incinerator site will be fenced and full-time security will be provided. The incinerator will require a reliable electrical power source, an un-interruptible fuel supply, and a water supply. In the event of a prolonged power outage the incinerator will be safely and securely shut down using a back-up power supply (possibly diesel fuel generator). The preferred location of the incinerator will consider the availability of these services. Access roads with suitable subgrades and base materials will be required to transport the incinerator equipment to and from the incinerator site, primarily due to the weight of the primary and secondary combustion chambers.

5.2.2 Office, Decontamination Facilities, Washrooms, Lunchrooms

Access to the incinerator and other operational areas of the incinerator site will be controlled to protect employees and the public and to minimize the potential for cross-contamination.

Support facilities, in the form of mobile trailers, will be used for activities including offices, lunchrooms, washrooms, showers, and decontamination facilities. Areas of the site will be designated as hot zones (i.e., contaminated areas), operational zones, and material staging areas. Access to each area will be restricted with various levels of personal protective equipment used, depending on the specific area.

Typically, an entrance trailer with a sign–in logbook or punch card system is used to account for each employee on the site. This area can also provide project specific information to interested members of the public or the media. Any individual entering or exiting the site will be directed through a safety equipment trailer or facility to don the appropriate safety equipment.

A change room, complete with lockers, for site employees will be provided where staff will remove street clothes and don coveralls and clean safety equipment such as tyveks, gloves, respirators, and hard hats. Boots will usually remain in a contaminated room or designated hot zone area to minimize decontamination requirements. Boots can be numbered or have the employee's name written on the inside near the top to eliminate the potential for cross-contamination where contaminated boots are inadvertently worn in a clean area. Safety equipment not scheduled for decontamination will be placed in designated containers located inside the decontamination facilities (usually drums) and taken to the hot zone for incineration once the container is full.

Showers and washroom facilities will be strategically located to allow employees to directly enter these areas immediately after exiting the hot zone and removing potentially contaminated safety equipment. Wastewater from showers and the laundry will be captured and transported to the water treatment plant.

Lunchrooms will be appropriately sized and located in close proximity to the site. All employees using the lunch facilities will be required to follow personal hygiene procedures mandated by the HASP.

Accommodations will be made for both male and female site employees and visitors. Shift changes could result in periodic overcrowding of facilities. The incinerator contractor will determine the size and arrangement of these facilities.

5.2.3 Materials Staging Area

A steady supply of contaminated input materials is required to optimise the incinerator operations. This will require a specific staging area where stockpiles of contaminated material are prepared and approved for processing into the incinerator. Due to the high cost of operation, a continuous feed process is optimal. Staging areas will be large enough to allow for several days of feedstock. Space will be provided to weigh the material to ensure that tonnage restrictions imposed as part of any permit approval are not exceeded. Weigh scales will be accessible and periodically calibrated to ensure compliance.

The staging area will be designated as a contaminated area (i.e., hot zone) throughout the incineration project and any access to this area by employees, inspectors, mechanics, equipment operators, etc., will require personal protective equipment (PPE). The floor of the hot zone will be constructed out of concrete. Upon completion of incineration activities, the concrete pad will require high-pressure washing and disposal at a secure landfill, possibly on-site.

A distinct wall or curtain will be constructed to separate the hot zone from the operational components of the incinerator. As long as the incinerator is operating properly, the areas immediately adjacent to the primary and secondary combustion chambers, as well as the boiler, packed tower, scrubbers, and stack, will remain clean. These areas, although restricted to authorized personnel, will not generally require PPE other than typical construction safety equipment such as hard hats, safety boots and safety glasses. The need to ensure that this operational area remains clean is essential to a successful program. Routine inspection of monitors, thermocouples, cooling systems, elbows, piping, etc., and all ancillary equipment will be conducted without PPE.

Access to the stack will be provided during incinerator start-up to confirm that stack emissions are satisfactory and that the incinerator meets DRE targets. Since the incinerator will operate for several years it is anticipated that several stack tests will be required to prove that the incinerator continues to operate within the parameters stipulated in the approvals permit.

Access to the control room is also, typically, made through the operational area. During routine maintenance in this area, tools, equipment, and replacement parts will be considered potentially contaminated and specific restrictions on the use of PPE will be implemented. Any materials or equipment with the potential for contact with contaminated equipment will be segregated and transferred to a decontamination area or into the hot zone for incineration.

Untreated PCB material, material awaiting confirmation of treatment, and treated materials will be segregated and stored in different areas with signs noting the type of material. Solid materials that pass through the incinerator will be handled as if it is contaminated until analytical results prove that the materials have been treated successfully. There are a variety of methods of staging treated materials as they are released from the incinerator (e.g., lugger bins, 3-walled concrete bins, stockpiles, etc.).

The incinerated material, commonly referred to as ash, will be stockpiled until a representative volume of ash has been collected. Analysis of the ash will be completed within 1 to 3 days by a CAEAL certified laboratory on or near the site. Analysis will be performed for PCBs, PAHs, metals, VOCs, dioxins, furans, and leachate to ensure ongoing compliance with regulatory requirements. Ash will only be cleared for release from the site, once the analytical results confirm that it was successfully treated and meets disposal criteria. A formal Release Form with appropriate signatures will document this process. For Quality Assurance/Quality Control (QA/QC) purposes, duplicate samples will be sent intermittently to a separate analytical laboratory for confirmation and verification. In addition, travel blanks and travel spikes will also be sent to laboratories as part of the QA/QC program.

Incinerated materials that meet disposal criteria will be inert and unlikely to support vegetative growth. These materials will be stockpiled and used as granular fill where appropriate.

The treated materials staging area does not need to be designated as a hot zone, however, access to the treated ash for sampling and inspection purposes will be conducted using proper PPE similar to that utilized in the hot zone. The treated material staging area will be adequately sized to consider throughput of the incinerator, size of ash stockpiles or containers, and analytical turnaround times. Contingency allowance is required should analysis confirm that ash has not been successfully treated and needs to be transported back to the hot zone for re-treatment. The staging area will also be sized to accommodate the water treatment operations required for the incinerator.

Considering the length of time required to deal with the volume of contaminated materials (approximately 3 to 5 years), the staging areas, hot zone, and ancillary infrastructure will be enclosed in a climate-controlled facility. Successful projects in Goose Bay, Labrador and Smithville, Ontario used structures for the specific purpose of continuous operation throughout all seasons.

5.2.4 Installation and Commissioning

Once approval is granted, arrangements with the selected contractor will be made to transport the incinerator to the site. The site mobilization is, generally, anticipated to require 6 to 8 weeks.

The incinerator will be supported on a concrete pad. The pad provides an extra precaution in the event of a spill from the incinerator. Installation of the concrete pad will be coordinated with any on-site underground utilities and the connection points located in the appropriate position for easy hook-up once the incinerator is brought on-site.

The primary combustion chamber will likely have refractory brick installed at the site, as installation prior to arrival at the site would make the primary combustion chamber too heavy for transportation via roadway.

Incinerator start–up will take several days while the equipment slowly heats up to the temperatures stipulated in the operational permit. This start-up phase will provide the contractor with an opportunity to ensure that all systems, gauges, thermocouples, and monitors function properly and to calibrate all aspects of the incineration process. This is also the time when a batch or stockpile of contaminated materials will be prepared for processing as part of the test burn program.

A successful test burn is a key requirement of receiving the permit to operate. The test burn program will be conducted under very tightly controlled conditions using a known volume of contaminated material with clearly documented levels of contaminants. During the test burn, full stack sampling equipment will be set up on scaffolding around the stack and continuous air sampling will be conducted. Air samples will be drawn from the stack into measuring equipment for later analysis at an analytical laboratory. The analytical results will be used to confirm that the incinerator achieves the targeted DRE. Ambient air monitoring testing will also be conducted before, during, and after the test burn. Operation of the incinerator from this point forward will be governed by the procedures established during the test burn and monitoring data collected during incineration.

5.2.5 Operations and Monitoring Plan

Only qualified operators will be employed on the incinerator. A comprehensive monitoring program will be developed and implemented to verify the incinerator's compliance with municipal, provincial and federal regulatory requirements. Monitoring programs for the incinerator will be divided into 4 key categories:

1. Process Monitoring: Operating conditions of the incinerator will be continuously recorded through computer software and hardware. This includes operating conditions such as minimum operating temperatures, maximum allowable feed rates, and proper functioning of automatic waste feed shut offs.
2. Effluent Monitoring: Prior to removal/discharge from the site, all effluent streams (such as wastewater, incinerated materials, and stack emissions) will be analyzed. In addition, feed materials will be analyzed to verify influent concentrations.
3. Decontamination Monitoring: Prior to removal/discharge from the site or exiting any contaminated areas (such as the hot zone), equipment will be surface tested to ensure adequate decontamination. Decontamination monitoring will also apply to on-site trailers and other infrastructure during demobilization at the end of the project.
4. Ambient Environment Monitoring: Ambient air, soil, waste, and sediment will be analysed for a variety of parameters to monitor changes, if any, to the natural environment surrounding the incineration operation and to ensure compliance with air quality regulations. Noise levels will also be monitored to ensure compliance with Provincial guidelines and Municipal By-laws.

Throughout the incineration component, regulatory agencies and the clients' representative or project manager will constantly monitor the contractor's activities. All individuals responsible for monitoring the incinerator operations will undergo a training and orientation program provided by the selected contractor prior to incineration start-up. It is essential that individuals monitoring the intricate operations of an incinerator understand what to look for and what various readings, measurements, and recordings represent. Every incinerator has a control tower with an extensive array of electronic cables, dials, gauges, switches, lights, and continuous emission monitors. Data will be obtained and analysed on an instantaneous, hourly, daily or weekly basis depending on the requirements of the conditions stipulated in the approvals Permit.

All inspectors entering the control tower will be certified. Health and safety training will be part of the orientation program (i.e., Hazardous Waste Operations and Emergency Response *a.k.a.* Hazwoper), as will the procedures for donning and removing PPE in such a way to minimize the potential for direct exposure to contaminated materials. A HASP will be developed for the incinerator that will specify medical checks for personnel before and during and after employment. In addition to a site specific HASP, an operations manual will be provided by the contractor during the orientation training program to be used as a reference document in any ongoing project management capacity.

5.2.6 Incinerator Decommissioning

The incinerator will be operated for a relatively short period of time, possibly 3 to 5 years, be disassembled, and trucked off of the site at the end of the project.

In preparation for the completion of incineration, pre-demobilization activities will be planned well in advance to ensure that contaminated materials are properly decontaminated prior to incinerator shutdown.

5.2.6.1 Incineration of Remaining Contaminated Materials

Pre-demobilization activities will include:

- Dismantling buildings and high pressure washing of equipment and surfaces followed by confirmatory testing.
- Sampling, excavation, and incineration of contaminated gravel and/or concrete on the operational areas of the site.
- Removal and incineration of any infrastructure or equipment that cannot be cost-effectively decontaminated.
- Removal of water treatment facility and incineration of contaminated filter media.
- Incineration of any contaminated water generated after decommissioning of the water treatment facility or shipping contaminated water to another treatment facility.
- Incineration of any filter media used to minimize fugitive emissions from the incinerator building and/or hot zone area.
- Removal, testing, and possible incineration of any impermeable membranes installed at project start-up.
- Removal of all underground and/or aboveground utilities if no longer required.

5.2.6.2 Decontamination, Confirmatory Testing, and Removal of Equipment

As soon as analytical confirmation has been received from the laboratory, Release Forms will be signed authorizing the release of the identified item from the quarantine area. During demobilization activities, efforts will be made to avoid storage space issues related to a potentially large amount of equipment that is awaiting release. Different remediation criteria for various media (steel, wood, concrete, water, rubber tires, etc) will be established prior to project start-up and enforced during demobilization activities.

5.2.6.3 Removal of Hazardous Materials

Any hazardous materials that cannot be incinerated (such as where the incinerator is not approved to deal with the hazardous material or the incinerator has been shut down) will be managed and disposed of in an approved manner. Ideally, the opportunity for this to occur will be minimized as much as possible and full advantage will be made of the operational status of the incinerator as it "burns itself off the site".

5.2.6.4 Demobilization

Demobilization activities will require several months to complete. Temporary facilities will be removed before the incineration equipment is dismantled and transported off-site. Large cranes will be used to erect and dismantle the various components that comprise the incinerator.

5.2.6.5 Confirmatory Testing and Site Restoration

The site selected for the incinerator will be sampled prior to construction to confirm baseline soil concentrations. The site will be resampled at the end of the project to confirm no negative impact has occurred. A topographical survey will also be completed in the event that surface materials become inadvertently contaminated and quantities of soil, concrete, or granular sub-base materials require excavation, measurement, incineration, and payment.

5.3 OFF-SITE RESOURCE REQUIREMENTS

5.3.1 Land Use

The incinerator will be located off-site at a location to be determined. The site will need transportation access and the provision of utilities such as water and electricity.

5.3.2 Resources/Materials

A partial list is provided below of the resources and materials that will be used during incinerator operation:

- Potable water from the Municipality will be used for showers, lunchrooms, and washrooms. Water will also be used for decontamination of trucks leaving the site at the wash pad, and incinerator cooling.
- A connection to the municipal sewer will be required for sewage from noncontaminated areas of the site such as washrooms and lunchrooms.
- One or more laboratories will be used to provide analytical testing services. These will include local or on-site facilities for routine testing and more specialized facilities for nonroutine testing.
- Fuel oil or propane will be used for the incinerator. This will be stored in bulk tanks on the incinerator site.
- Granular materials such as slag, gravel and rip rap will be used for access road construction, if required.
- Piping might be used for well casings and for management of surface and groundwater.
- Fill, topsoil, plantings will be used as part of the final site restoration and landscaping.
- Fuel will be used for vehicles and equipment that will be dedicated to the contaminated areas of the site.

5.3.3 Waste Disposal

Waste generation and off-site disposal of wastes will be minimized where feasible. The anticipated waste streams and proposed methods of disposal are as follows:

- Ash produced from the incinerator will be tested to meet emission standards and also assessed for acceptance as fill at the Tar Ponds or Coke Ovens sites. This assessment will likely require routine leachate analysis. The Tar Ponds site will require substantial fill materials and the ash will be an important source of bulk fill prior to capping. Alternatively the ash might be disposed in a secure landfill.

- The air pollution control system for an incinerator dealing with PCBs is typically a wet scrubbing system that removes particulates and acid from the gases. The gases, which are highly concentrated with hydrogen chloride (HCl), are scrubbed with water containing caustic (sodium hydroxide (NaOH)), which results in the formation of salt (sodium chloride, NaCl). This resulting mixture of water and salt is referred to as brine because of the salt content. To reduce the quantity of brine requiring disposal, much of the brine will be re-circulated back into the air pollution control system and also concentrated in an evaporator. The resulting brine, which needs to be removed from the system periodically has a high concentration of salts and, therefore, requires disposal at a registered waste disposal company. Prior to release from the site the brine will be sampled and analysed.
- Particulate matter from the air pollution system will be analyzed and disposed of in an approved manner;
- Nonhazardous domestic wastes (administration, lunch room, etc.) will be sent to the local licensed municipal facility.
- A connection to the municipal sewer will be required for sewage from noncontaminated areas of the site such as washrooms and lunch rooms.
- Contaminated combustible materials that are generated during the cleanup, such as personal protective equipment, will be directed to the incinerator for destruction. Such materials generated during periods when the incinerator is not operating will be decontaminated, if possible, and removed from site and transferred to a waste facility licensed to accept them.
- Treated noncombustible materials, such as old bricks, concrete, piping, reinforcement steel, and other such materials will be buried on the Coke Ovens site or disposed at an approved and licensed waste disposal facility.
- Sanitary sewage from washrooms and food processing areas will be disposed to the municipal system. Wastewater from showers and washbasins in the personnel decontamination area will be treated in the water treatment plant to be constructed as part of the remediation project.
- Maintenance wastes, such as oils and filters from excavating equipment, will be shipped used as supplemental fuel for the incinerator.

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APPENDIX A

Memorandum of Agreement for the Remediation of the Sydney Tar Ponds and Coke Ovens Sites

Memorandum of Agreement

Remediation of the Sydney Tar Ponds and Coke Ovens Sites in the Cape Breton Regional Municipality ("MOA")

between

Her Majesty the Queen in Right of Canada as represented by the
Minister of Public Works and Government Services ("Canada")

and

Her Majesty the Queen in Right of Nova Scotia as represented
by the Premier of Nova Scotia ("Nova Scotia")

WHEREAS the Government of Canada and the Province of Nova Scotia recognize that the residents of Cape Breton Regional Municipality and First Nations peoples desire that effective and timely action be taken to address their concerns over the current environmental condition of the Sydney Tar Ponds and Coke Ovens sites; and

WHEREAS the Government of Canada and the Province of Nova Scotia are committed to the principles of sustainable development in recognizing the environmental, social and economic dimensions of the Sydney Tar Ponds and Coke Ovens sites; and

WHEREAS the Governments of Canada and the Province of Nova Scotia desire to address these issues in a collaborative and equitable manner and have reached an agreement to take permanent measures by commencing a project with long term benefits for all Canadians and in particular the residents of Nova Scotia.

NOW THEREFORE Canada and Nova Scotia ("the Parties"), involving their respective departments and agencies and using the appropriate strengths and resources of each, in collaboration, agree as follows:

1. 0 The Project

1.1 The Parties will undertake a project (the "Project") for the remediation of the Sydney Tar Ponds and Coke Ovens sites, involving (a) the federally and provincially owned portions of the South and North Ponds of Muggah Creek to Battery Point; and (b) the federally and provincially owned portions of the Coke Ovens Site, including Mullins Bank.

1. 2 Subject to a joint Environmental Assessment and to section 2.1, the Project shall include:

- the removal and destruction of PCBs from the tar ponds as well as the removal and destruction of the contents of the tar cell on the coke ovens site with a proven technology such as high temperature incineration in a single use dedicated facility;

- the in-place treatment of the remaining contaminated material using proven technology such as bioremediation, solidification or other appropriate technology;

- the subsequent engineered containment of both sites;

- site restoration and landscaping compatible with the natural surroundings and future use; and

- provision for the ongoing future maintenance and monitoring of the sites for 25 years after completion of the Project.

1.3 The Parties shall enter into an agreement describing in detail the specific elements of the Project over a 10 year period, subject to any unforeseen necessary extensions or matters to be addressed jointly, which shall not exceed the scope of the work described in subsection 1.2 above ("the Project Description"). The Project Description will also include a description of the legal survey boundaries of the sites. Upon completion of the Project the Parties agree that the sites will have been remediated in accordance with the intent of this MOA, subject to its provisions, notwithstanding any other meaning of the word remediation.

1.4 Immediately upon the signing of this MOA the Parties will undertake the activities set out in Section 4.

1.5 The Parties will carry out a joint Environmental Assessment of the Project.

1.6 Nova Scotia shall establish a single purpose entity that shall commence operation by September 30, 2004 to manage and implement the Project. This entity shall deliver the Project in a timely and cost effective manner and will have clear accountabilities to be demonstrated through agreed upon monitoring processes. Until this entity has commenced operations, the Sydney Tar Ponds Agency will serve as the managing and implementing agency.

1.7 Nova Scotia shall be the lead Party for the Project, shall be responsible for the overall management and implementation of the Project, shall, among other things, make use of independent engineering assessments and audits and shall provide full and open access to Canada to all results and procedures.

1.8 Upon issuance of the appropriate Certificate of Project Completion by the Independent Engineer appointed pursuant to Section 3, certifying that the Project has been completed in accordance with the Project Description (as may have been jointly amended during the implementation of the Project to address unforeseen issues or that result from the joint Environmental Assessment) Nova Scotia shall accept full ownership of the sites, except in the event any validated third party claims or interests therein have been established, and shall be responsible for any contemplated future development and any future impact to or on the sites from such development, as well as for all ongoing future maintenance and monitoring of the sites.

2.0 Project Funding

2.1 Notwithstanding anything else contained herein, the total cost of the Project shall not exceed four hundred million ($400,000,000) dollars.

2.2 Nova Scotia shall contribute to the cost of the Project the lesser of 40% of the actual cost incurred or one hundred twenty million ($120,000,000) dollars.

2.3 Canada shall contribute to the cost of the Project an amount that will not exceed two hundred eighty million ($280,000,000) dollars.

2.4 No portion of the respective shares shall be paid in kind.

2.5 It is intended that the funding provided under this MOA shall also be used for preventative works described in Table 1 designed to contain and limit any currently occurring dispersion of contaminants such as the installation of a coffer dam at Battery Point and rerouting of Coke Ovens Brook, as well as the other activities referred to in Section 4 and the preliminary works also described in Table 1.

2.6 The Parties intend that the Project will be managed in accordance with the terms of this MOA and that there shall be no Project cost overruns. In the event that there are Project cost overruns, they shall be the responsibility of Nova Scotia. The cost of any work, over and above the work set forth in the Project Description, which may by law, regulation or mandatory directive be required to be performed at some future date whether before or after the Project is completed, shall be addressed jointly by both Parties and shall not be a cost overrun.

2.7 An increase in the cost of the Project that arises from the subsequent discovery of the occurrence of significant contamination in or on the sites not known to, or due to circumstances not foreseen by, the Parties at the time of the signing of the cost-share agreement shall be addressed jointly by both Parties and shall not be a cost overrun.

2.8 It is understood and accepted that there are currently no obligations on either Party to conduct and fund any more work than that described in the Project Description and this understanding and acceptance is the basis of the intent of the Parties in entering into this MOA. Notwithstanding this intent, if a court of competent jurisdiction makes an order, after all appeals have been exhausted and whether before or after the Project is completed, that requires Canada, Nova Scotia or both to conduct work on the sites beyond the Project Description or orders the payment of damages related to the Project, and the cause of action resulting in the order does not relate to the management or implementation of the Project by Nova Scotia, the Parties agree to jointly address those matters and the costs related thereto shall not be a cost overrun.

3.0 Governance

3.1 The Parties shall jointly appoint an individual to be the Independent Engineer who shall be independent of both Parties and perform the duties contemplated under an agreement to be entered into under Section 5. The fees of the Independent Engineer shall be paid out of the funds allocated under this MOA.

3.2 The Parties will continue to consider all Project stakeholders by respecting their interests, including development of a community liaison strategy.

3.3 The Parties will continue consultation with the First Nation community to enable meaningful participation in economic activity including the development of an aboriginal procurement strategy.

3.4 The Parties will foster opportunities for sustainable development activities.

3.5 The Parties will develop and manage appropriate communications with all Project stakeholders respecting both federal and provincial protocols.

4.0 Preliminary Costs

4.1 In the interim period, from the date of signing of this MOA until the cost-share agreement described in Section 5 is executed, the Parties agree to fund planning, environmental assessment and preliminary preparation costs and associated works through an interim governance and funding approval arrangement described in Section 5.

4.2 The above activities as well as the preventative works and the preliminary works identified in Table 1 attached will comprise a component of the cost-share agreement.

5.0 Implementation Agreements

5.1 Canada and Nova Scotia, represented respectively by the Minister of Public Works and Government Services and the Sydney Tar Ponds Agency will enter into immediate discussions to conclude implementation agreements that will include, but not be limited to the following:

- An interim governance and funding approval agreement;
- An agreement concerning the process for undertaking preventative works and preliminary works identified in Table 1;
- An agreement describing in detail the specific elements of the Project which shall not exceed the scope of the Project described in sub-section 1.2;
- A cost-share agreement to be approved by the Treasury Board of Canada and the Lieutenant Governor-in-Council that will include financial and governance arrangements that will ensure that each of Canada and Nova Scotia independently are able to exercise appropriate due diligence over Project

management costs and expenditures; will include a process to jointly address matters where referred to herein; and that will include a formal Communications Protocol;

- An agreement to carry out a joint Environmental Assessment; and
- An agreement to jointly appoint an Independent Engineer setting out the duties of the Independent Engineer and the terms and conditions of the appointment.

5.2 The Parties shall respect the principles and guidelines set out in Annex A attached in entering into the agreements set out in this Section 5.

6.0 **Final Provisions**

The Parties agree:

a. to jointly address any required emergency response action in situations where in the opinion of an independent engineer a catastrophic impairment of the Project occurs or could occur as a result of natural disasters or acts of God whether before or after the completion of the Project; and

b. that nothing in this MOA shall be construed as an admission of liability in whole or in part by either Party or prevents either Party in taking any action or raising any defence in defending or advancing its interest in any ongoing or future litigation related in any way to the Sydney Tar Ponds or Coke Ovens Sites.

Signed and dated this 12th day of May, 2004 at Sydney, Nova Scotia.

Government of Canada	**Province of Nova Scotia**
______________________________	______________________________
Minister of Public Works and Government Services	**Premier of Nova Scotia**

Table 1

Preventative Works

Description	**Estimated Costs 2004-2005**
Coffer Dam Engineering Design	$ 500,000
Cooling Pond Engineering Design and Implementation	1,000,000
Realignment of Coke Ovens Brook Engineering Design	300,000
Relocation of Whitney Pier Water Line Engineering Design	50,000
Leachate Collection System Engineering Design	250,000
Total	$ 2,100,000

Preliminary Works

Description	**Estimated Costs 2004-2005**
Environmental Assessment Review	$ 1,000,000
Project Description Development	150,000
Site Preparation	250,000
Selection and Engagement of Independent Engineer	300,000
Work Breakdown Structure Development	200,000
Development of Cost to Complete Project Mechanism	125,000
Development of Risk Assessment Strategy	125,000
Development of Results Based Accountability Framework	150,000
Establishment, Organizational Development of Implementing Agency	$1,000,000
Total	$ 3,300,000

Note: All Estimated Costs are based upon Class "D" Estimates

ANNEX A

In entering into, and implementing the Agreements described in Section 5 of the Memorandum of Agreement, the Parties will be guided by the following principles.

1. Management Accountability Principles

The Project:

- will be resourced by both levels of government in accordance with necessary funding appropriation procedures that will include a work breakdown structure;
- will include appropriate governance arrangements for ministerial accountability and reporting to the provincial Legislature and the federal Parliament;
- will have appropriate mechanisms in place to permit long term management, monitoring and corrective action, where necessary;
- will be subject to a jointly conducted environmental assessment;
- will respect federal and provincial principles and policies in planning and implementation; and
- will adhere to all relevant federal, provincial and municipal laws and regulations.

2. Project Management Principles

The Project:

- will respect principles of fairness, openness, transparency and competitiveness;
- will have well defined objectives with clear accountabilities;
- will have a sound structure for ongoing decision making (including work breakdown and activity approvals) in accordance with mutually acceptable approval requirements;
- will use a comprehensive and coordinated definition of the overall scope of the Project;
- will contribute to the development of best practices related to the management of contaminated sites; and
- will, through the Parties, jointly address any measures required as a result of any changes to environmental standards, policy or law affecting the Project, which occur prior or subsequent to completion.

3. Risk Management Principles

The Project:

- will always focus on reducing any currently known or subsequently identified risks to human health, safety and the environment;
- will be managed in a manner sensitive to risk, complexity and economy of resources;
- will continue to undertake rational priority setting through a systematic identification and categorization of risks, including any litigation risks, and the development of management plans on an ongoing basis throughout the life of the Project;
- will strive to make best use of financial and technological resources through risk management approaches, including the development of an appropriate risk management strategy and appropriate reporting by the independent engineer of adherence to that strategy; and
- will, through the parties, consider responsibility for mitigation of any future liabilities associated with the site through appropriate covenants;

4. Communications

Communications and public information will follow mutually agreed upon strategies recognizing the federal and provincial nature of this MOA and the communications policies of both levels of government.

APPENDIX B

PCB Destruction Technology Siting Study

REMEDIATION OF THE SYDNEY TAR PONDS AND COKE OVENS SITES

DESTRUCTION TECHNOLOGY SITING STUDY

Prepared for:

NOVA SCOTIA

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December 2004

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1.0 INTRODUCTION

The Sydney Tar Ponds Agency (STPA) intends to remediate the Sydney Tar Ponds and Coke Ovens Sites located in Cape Breton Regional Municipality, Nova Scotia (see Figure 1.1). Part of the remediation strategy developed jointly by STPA and Environment Canada for the Tar Ponds and Coke Ovens Sites includes destruction of selected PCB and non-PCB containing soils and sediments using an approved, temporary incinerator.

AMEC Earth & Environmental was requested by the STPA to develop and implement a process to select a suitable site for a temporary PCB incinerator. This report summarizes the site selection process, and the results of this process.

1.1 PROJECT BACKGROUND

The Coke Ovens Site is a former industrial property, approximately 68 hectares (ha) in area, in Sydney Nova Scotia, bounded by residential and former industrial developments (Figure 1.1). The Coke Ovens Site contained a coke production facility for 90 years (closed in 1988) that provided raw carbon feedstock and fuel for the nearby steel mill. Other industrial facilities were located on the site and used by-products of the coking operations in the manufacture of commercial goods and products. An estimated 280,000 m^3 (560,000 tonnes) of soil and sediment on the Coke Ovens Site is contaminated with, primarily, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), and metals. Included in this total is PAH contaminated soil in an in-ground Tar Cell and PAH contaminated sediment in Coke Oven Brook, the primary drainage course on the site.

The Tar Ponds (including the North and South Tar Ponds) is the name given to a portion of Muggah Creek near the Coke Ovens Site that received industrial discharges from upstream industrial activities. The North Pond is open to Sydney Harbour and at high tide covers an area of 18.6 ha. It contains an estimated 280,000 m^3 (360,000 tonnes) of contaminated sediments. The South Pond is separated from the North Pond by a man-made cofferdam and covers an area of 12.9 ha. It contains an estimated 270,000 m^3 (350,000 tonnes) of contaminated sediments. Contaminants in the Tar Ponds include, primarily, PAHs, metals, and polychlorinated biphenyls (PCBs). Approximately 45,000 m^3 (59,000 tonnes) of the sediment in the Tar Ponds is contaminated with PCBs.

Public input and the Remedial Action Evaluation Report were considered in the development of the remediation strategy for the Tar Ponds and Coke Ovens. The remediation strategy consists of several components, one of which includes removing sediments containing PCB material from the Tar Ponds, PAH contaminated sediment from Coke Ovens Brook (on the Coke Ovens Site), and PAH contaminated soil from the in-ground Tar Cell (on the Coke Ovens Site), and destroying them in an approved, temporary incinerator that will be set up off-site, near the Tar Ponds/Coke Ovens sites.

2.0 SITE SELECTION CRITERIA

2.1 PRIMARY PRINCIPLES

The selection process for the proposed incinerator site was based on two primary principles:

1) Demonstrated protection of public health and safety and the environment is paramount and a prerequisite to the acceptance of any site; and
2) Social, technical, and economic considerations, although important to the overall viability of a site and the Project, are secondary, in comparison to health, safety, and the environment.

With these principles in mind, criteria for the site selection process were developed as part of this Report, and were then used to first develop a list of potential sites and then select 4 candidate sites (one preferred, and alternates).

2.2 DEVELOPMENT OF SITING CRITERIA

The objective of the overall site selection process was to identify a short list of acceptable sites for the location for a temporary incinerator to destroy selected wastes from the Sydney Tar Ponds and Coke Ovens sites. The term "acceptable" was defined in terms of the principles above, and the ability of the site to meet certain criteria with respect to protection of health, safety, the environment, financial viability, and technical/engineering requirements.

To assist in developing temporary incinerator site selection criteria for use in Sydney, AMEC reviewed PCB incinerator and hazardous waste treatment facility siting criteria from various jurisdictions and agencies throughout Canada and the United States. Canadian information was gathered from the Government of Canada (1999), the Canadian Council of Ministers of the Environment (CCME, 1990), the Atlantic Canada Mobile PCB Incinerator Program (Environment Canada, 1992); and the provinces of Alberta (Province of Alberta, 2004), British Columbia (Province of British Columbia, 2000), Ontario (Province of Ontario, 1990), and Quebec (Province of Quebec, 2004). American site selection information was gathered from the United States Environmental Protection Agency (USEPA, 2004a) for Arizona, Arkansas, Connecticut, Florida, Georgia, Hawaii, Illinois, Indiana, Louisiana, Massachusetts, Michigan, Mississippi, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Puerto Rico, Tennessee, Texas, West Virginia, and several other USEPA references (USEPA, 1997, 2000, 2002, and 2004b).

Siting criteria from all jurisdictions were assembled in a database and compared for similarities. What was noticed from this comparative analysis was a general commonality of emphasis on 1) protecting of public health through minimum setback distances from developed urban or rural areas (churches, parks, playgrounds, etc.), 2) avoiding sensitive environments such as wetlands and floodplains, 3) avoiding technically problematic areas such as geologic faults, mines and sinkholes (subsidence), and highly erodible coasts or soils, and 4) and a requirement for public input. While these issues were consistent across jurisdictions, there was no consensus among jurisdictions on the recommended distances from developed areas, sensitive environmental features, technically problematic areas, or any other identified constraints.

Using the existing siting criteria from these various jurisdictions, a set of project-specific siting criteria was developed. Similar to those criteria developed for the previous Atlantic Canada Mobile PCB Incinerator Program (Environment Canada, 1992), the site selection process was based on a multi-tiered evaluation. As some of the objectives of that previous program were not applicable to this Project, and additional Project related issues were already known, these criteria were modified. These modifications were based on the specifics of this Project, pertinent information from other jurisdictions, and STPA input.

Two levels of criteria (Level 1 and Level II) were applied to narrow down the number of sites that would be acceptable for siting a temporary incinerator.

Level I criteria (see Table 2.1) were, generally, exclusionary criteria and set minimum standards that must be met for any site to be considered further.

TABLE 2.1 Level I Site Selection Criteria

#	Category		Level I Criteria
1	Land Ownership	a.	Preferred land ownership of Site locations is the Federal, Provincial or Municipal governments or associated Crown corporations.
		b.	Site locations must be within a 20 km radius of the source of contaminated material.
2	Public Health and Safety Considerations	a.	Earthquake and seismic prone areas (within 61 m of a fault) will not be considered.
		b.	Areas within 500 meters of residences, occupied public buildings, designated park, outdoor recreation area, food processing facilities, feed lots, farming or aquaculture operations, will not be considered.
3	Natural Environmental Considerations	a.	Environmentally Significant Areas such as watercourse protection areas, or natural environment areas, will not be considered (as designated by Federal, Provincial, or Municipal authorities).
		b.	Designated Flood Way areas, 100-year floodplains, aquifers, watersheds, water supply areas, and recharge areas identified by local conservation or other specified authorities will not be considered.
		c.	Designated natural resource areas (i.e. Wildlife Management Areas, Wetland Habitat, and Endangered Species Habitat), and silviculture areas including enhanced forests, plantations, and thinned areas on Crown land, as identified by appropriate government agencies will not be considered.
		d.	Designated conservation areas, national, provincial and municipal parks and playgrounds will not be considered.
		e.	Hazard lands including closed landfills, areas of Karst topography, areas of known surface or shallow subsurface mining, or land with unsuitable topography will not be considered.
		f.	Areas within 100 meters of a permanent (year round flow) watercourse will not be considered.
		g.	Areas where the surficial soil does not have suitable characteristics to mitigate or contain potential spills, and for whatever reason cannot accommodate a liner, will not be considered.
4	Social/Cultural Considerations	a.	Potential sites outside the political/administrative boundaries of the CBRM will not be considered.
		b.	Lands within existing residential areas will not be considered.
		c.	Areas that include major features of known historical, cultural or archaeological value will not be considered.
		d.	Special agricultural or aquaculture operations will not be considered.
5	Economic/Financial Considerations	a.	No major constraints to identifying potential sites.
6	Technical Considerations	a.	Major underground or overhead utility corridor easements will not be considered.
		b.	Candidate Sites less than two hectares in size will not be considered.
		c.	Sites must have acceptable potential for services (electricity, water).
		d.	Sites will not be located where seasonal road weight restrictions will be exceeded.
		e.	Availability of site access by rail or road.

Key to these criteria were 1) a site must not have a residence located within 500 m of its property boundary, 2) a site must be within 20 kilometres (km) of the Tar Ponds/Coke Ovens Site, 3) a site must be owned by the Federal, Provincial, or Municipal governments (i.e., private land will not be considered), and 4) a site must be greater than 2 hectares (ha) in area. These 4 criteria, in addition to the others shown in Table 2.1, were used to identify 10 potential incinerator sites from all of the Federal, Provincial, and Municipal properties within 20 km of the

Tar Ponds. Sites that did not meet any one of the Level I criteria were omitted from any further consideration. For example, if a property had a residence within 500 metres (m) of its boundary, or a year-round watercourse was located within 100 m, then the site was no longer considered.

Level II criteria (see Table 2.2) are a combination of quantitative and qualitative criteria used to conduct a comparative analysis of the 10 potential sites (identified using Level I criteria) and rank them from most acceptable to least acceptable.

TABLE 2.2 Level II Site Selection Criteria

#	Category		Level II Criteria
1	Public Health and Safety Considerations	a.	Number of residences, occupied public buildings, food processing facilities, feed lots, farming or aquaculture operations, downwind from 500 to 1000 meters from a Potential Candidate Site.
		b.	Distance to emergency response facilities from a Potential Candidate Site.
2	Natural Environmental Considerations	a.	Number, extent and significance (i.e. Crown Forest, Woodland Improvement Area) of woodlots that would be cleared.
		b.	Number, extent and significance of a permanent (year round flow) watercourse from 100 to 500 meters form the site.
		c.	Presence of Environmentally Significant Areas (as designated by federal, provincial or municipal authorities) within 500 meters of a Potential Candidate Site (i.e. watercourse protection areas, natural environmental areas, hazard lands).
		d.	Designated natural resource areas within 500 meters of a Potential Candidate Site (i.e. Wildlife Management Areas, Wetlands Habitat and Endangered Species Habitat), and identified by appropriate government agencies.
		e.	Vegetation, aquatic habitat, terrestrial wildlife habitat on site and within 500 meters.
		f.	Presence and number of stream crossings and access routes.
		g.	Number of designated conservation areas or national, provincial, or municipal parks within 500 meters of a Potential Candidate Site.
		h.	Presence of surficial soil that has the potential to mitigate or contain potential spills.
		i.	Frequency of good dispersive conditions (based on data from Sydney airport).
		j.	Areas above an active or inactive shaft or tunneled mine or other areas of potential subsidence.
3	Social/Cultural Considerations	a.	Number of property ownerships required for the establishment of a Potential Candidate Site (private or public)
		b.	Number of buildings along the primary and secondary access roads to the Potential Candidate Site.
		c.	Presence of historical, archaeological or architecturally significant features within 500 meters of a Potential Candidate Site based on relevant government agency input.
		d.	Type of other land uses within 500 meters of a Potential Candidate Site.
		e.	Proximity to population concentrations.
		f.	Number and type of community and recreational features between 500 and 1000 meters of a Potential Candidate Site and along primary and secondary access routes.
4	Economic/Financial Considerations	a.	Distance to a Potential Candidate Site from unrestricted (weight) roads, highways
		b.	Distance from source of contaminated materials
		c.	Length of the primary access road requiring construction and/or improvement.
		d.	Transportation costs for materials and equipment
		e.	Estimated site acquisition cost.
5	Technical Considerations	a.	Access available by road and/or rail.
		b.	Total site area configuration. The site should be level with suitable foundation and surface area for the destruction units, support equipment and waste storage area. Appropriate access should exist for proper implementation of spill cleanup procedures.

The 4 most acceptable sites, which resulted from the Level II evaluation, were selected as candidate incinerator sites.

3.0 FINDINGS

3.1 LEVEL I CRITERIA

An evaluation of all Federal, Provincial, and Municipal properties within 20 km of the Tar Ponds was conducted by constraint mapping using the Level I criteria (see Table 2.1). The purpose was to eliminate properties that do not pass the minimum site selection criteria. Digital data of all of the Level I criteria (i.e., constraints) were obtained from the Province of Nova Scotia and Cape Breton Regional Municipality (CBRM) and input into a Geographical Information System (GIS) developed for this project. The GIS was used to identify areas that were suitable for a temporary incinerator (see Figure 2.1).

The result of the constraint mapping is that 10 government-owned properties were identified as meeting the Level I criteria (see Figure 2.2) and were carried forward as potential sites for evaluation using Level II criteria.

The 10 potential incinerator sites selected to move forward to the Level II evaluation included:

- Site 1: Cape Breton Development Corporation (CBDC) land near the settling pond, northwest of the former Victoria Junction Wash Plant, off Lingan Road;
- Site 2: CBDC, private, and NS lands near the former Pioneer Coal mine, east of the Sydney Airport, off Grand Lake Road;
- Site 3: CBRM land, east of Whitney Pier and north of the landfill and the railroad tracks;
- Site 4: CBRM land, southwest of Gilholmes Lake, off Mira Road;
- Site 5: CBRM lands near River Ryan, southwest of Kilkenny Lake, off Lingan Road;
- Site 6: CBDC lands near River Ryan, south of Waterford Lake, off Lingan Road;
- Site 7: CBDC land at the site of the former Victoria Junction Wash Plant, off Grand Lake Road;
- Site 8: CBDC lands, northeast of the Lingan Golf Course, off Grand Lake Road;
- Site 9: CBDC land, located at the inactive Phalen Mine site; and
- Site 10: CBDC land at North Head in Lingan.

3.2 LEVEL II CRITERIA

Level II was the first level of comparative evaluation among the 10 potential sites. After the Level I constraint mapping, the 10 potential sites were subjected to more restrictive analysis to identify disadvantages of their use as a site for a temporary incinerator (see Table 2.2). The 4 sites with the least significant constraints (highest scores) are referred to as candidate sites for the incinerator facilities. The following is a summary of the Level II criteria that were used to select the 4 candidate sites:

1. **Public Health and Safety** – As previously outlined, public health and safety have primary consideration in the siting of the incinerator facilities.
    a. Number of residences or occupied buildings from 500 to 1000 m downwind of the potential site – Since sites were screened out during Level I that had residences or occupied buildings within 500 m of the site, the next step was to evaluate beyond this distance in the direction of the prevalent winds. The downwind

qualifier is important in the event that upset conditions exist at the incinerator. For the purposes for this study, downwind was defined using existing climate data to identify statistical wind patterns (i.e. a wind rose). For the sites, a prevalent wind direction was in a Northeasterly direction and encompassed an angle of approximately 100°. While it is recognized that there will be variations in wind direction, for the purposes of this comparative analysis between sites, this is an appropriate assumption.

b. Distance to emergency response facilities – The sites were evaluated to consider the timeliness of a response in the event of emergency accidental events at the site.

2. **Natural Environmental Considerations** – Secondary to public health and safety but also of a high level of consideration are natural environmental features of the sites.

   a. Number, extent and significance (i.e. Crown Forest, Woodland Improvement Area) of woodlots that would be cleared – Sites were scored lower if considerable clearing of trees were required to develop the site, as opposed to a site that required limited or no clearing

   b. Number, extent and significance of a permanent (year round flow) watercourse from 100 to 500 meters form the site – Sites that had more watercourses near them were scored lower due to the potential effects to watercourse from the site development

   c. Presence of Environmentally Significant Areas within 500 meters of a Potential Candidate Site (i.e. watercourse protection areas, natural environmental areas, hazard lands) – Sites were evaluated for the presence of provincially or federally recognized ESAs in close proximity to avoid any potential effects to these features during site development.

   d. Designated natural resource areas within 500 meters of a Potential Candidate Site (i.e. Wildlife Management Areas, Wetlands Habitat and Endangered Species Habitat), and identified by appropriate government agencies - Sites were evaluated for the presence of provincially or federally recognized significant habitat features in close proximity to avoid any potential effects to these features during site development.

   e. Vegetation, aquatic habitat, terrestrial wildlife habitat on site and within 500 meters – Using aerial photographs, resource mapping, and site visits, a general description of the habitat on the site and surrounding area was developed. Sites that had relatively intact and undisturbed habitat features were given a lower score, as opposed to sites that had disturbed or fragmented habitat features.

   f. Presence and number of stream crossings and access routes – Sites were evaluated for potential access roads and the potential for watercourse crossings along those roads. Sites that had a higher number of watercourses crossings were scored lower due to the increased potential for effects on watercourses from the development of site access.

   g. Number of designated conservation areas or national, provincial, or municipal parks within 500 meters of a Potential Candidate Site property line – Sites were evaluated for the presence of areas that were set aside by government agencies for conservation purposes. Sites that had these features in proximity were scored lower.

h. Presence of surficial soil that has the potential to mitigate or contain potential spills – Sites that had soils that were more conducive to the type of activities that are proposed for these locations were scored higher.

i. Frequency of good dispersive conditions (based on data from Sydney airport) – Sites that had higher wind conditions and presented good dispersion for stack emissions were scored higher.

j. Areas above an active or inactive shaft or tunneled mine or other areas of potential subsidence – Areas that were subjected to mining and could have underground workings on the site were scored lower due to the potential for subsidence in these areas.

3. **Social/Cultural Considerations -** Secondary to public health and safety but also of a high level of consideration are social/cultural considerations.

a. Number of property ownerships required for the establishment of a Potential Candidate Site (private or public) – Sites that had fewer property owners were preferred to sites that had multiple owners and higher potential for prolonged negotiations.

b. Number of occupied buildings along the primary and secondary access roads to the Potential Candidate Site – Potential transportation routes were evaluated for the number of occupied buildings that would be passed by trucks driving from the Tar Ponds/ Coke Ovens Sites to the incinerator site. Sites were preferred if there were lower numbers of buildings from a noise, traffic and nuisance perspective.

c. Presence of historical, archaeological or architecturally significant features within 500 meters of a Potential Candidate Site – Sites that were identified by government resource agencies as having features that were historical or prehistorically significant were scored lower due the potential for disturbance of these features.

d. Type of other land uses within 500 meters of a Potential Candidate Site property line – The land uses that are adjacent to the sites were also examined. Sites that had a higher variability of uses or potentially incompatible uses received a lower score.

e. Proximity to population concentrations – Sites were evaluated for their proximity to populated centers, with more isolated sites receiving a higher score.

f. Number and type of community and recreational features between 500 and 1000 meters of a Potential Candidate Site property line and along primary and secondary access routes – These facilities that are frequented by residents were identified in areas adjacent to the site and along access routes. Sites where Project activities, and increases in traffic have the potential to negatively impact these activities, or create high levels of complaints were scored lower.

4. **Economic/Financial Considerations** – As there is a limited budget available for the incinerator component of the Tar Ponds/Coke Ovens Remediation Project, part of the decision making process needs to include the cost of developing the required facilities. While exact dollar figures are not yet available for a number of these criteria, relative costs can be evaluated between the sites.

   a. Distance to a Potential Candidate Site from unrestricted (weight) roads, highways – Due to the requirement to transport materials to the site year-round, it is important to have access to the site that is not restricted by seasonal weight restrictions. As a result, the sites that were in closer proximity to access roads that had no weight restrictions were scored higher.

   b. Distance from source of contaminated materials – A large part of the costs of the Project will be associated with the transportation of materials to the site. Sites that are closer to the Tar Ponds and Coke Ovens sites are preferred to those where trucking costs are higher due to longer distances.

   c. Length of the primary access road requiring construction and/or improvement – Its is recognized that most of the sites will require some upgrading or improving of the access roads into the sites to accommodate the transportation of material as well as the weight of the equipment that is required on the site. The shorter the length of the access road requiring construction or improvement, the lower the construction/upgrading costs, and therefore the higher the score.

   d. Transportation costs for materials and equipment – Most of the materials and equipment for the development and operation of the facility will be either sourced in Sydney or will be outsourced and then brought into Sydney. There is a cost to transport this equipment to the site, therefore, sites closer to Sydney are preferred.

   e. Estimated site acquisition cost – The costs of acquiring the site from the current owners will constitute part of the site development costs. While site costs are not known at this time, the relative costs of the sites can be compared between sites, with sites that are obtainable for a reasonable cost, scoring higher.

5. **Technical Considerations** – There are a number of technical requirements for the development of these types of facilities. Each of the sites will have some technical challenges but sites that are more conducive from a technical perspective were scored higher.

   a. Access available by road and/or rail – The potential exists that if suitable rail infrastructure is still in place, it may be possible to transport the material to the site via rail cars. The presence of both road and rail access is the most favorable consideration, with road only being less favorable, and rail only being the least favorable (road access is required in all situations)

   b. Total site area configuration - The site should be level with suitable foundation and surface area to meet site development requirements. Appropriate access at the site will need to exist or be created for proper materials handling and implementation of spill cleanup procedures. If extensive site development is required at a site, it received a lower score.

The 10 potential sites were evaluated using the Level II criteria described above. The results of this evaluation are shown in Table 2.3.

The sites were qualitatively evaluated against each other (e.g., very good, good, fair, poor) using these criteria to determine which 4 sites were most suitable for development as a site for the temporary incinerator. The ratings were based, in part, on the degree to which a site met the criteria. For example, a site with no subsidence issues rated very good, while, in comparison, a site with known subsidence issues rated poor. In addition, the ratings were

TABLE 2.3 Level II Potential Candidate Site Evaluation

TABLE 2.3 Level II Potential Candidate Site Evaluation

#	Criteria		Level II Criteria	Site 1 (Reservoir) Description	Score	Site 2 (airport) Description	Score	Site 3 (landfill) Description	Score	Site 4 (Mira Road) Description	Score	Site 5 (Kilkenny) Description	Score	Site 6 (Scotchtown) Description	Score	Site 7 (VJ Wash Plant) Description	Score	Site 8 (Crossroads) Description	Score	Site 9 (Phalen Mine Site) Description	Score	Site 10 (North Head) Description	Score
1	**Public Health and Safety Considerations (possible high score of 6)**	a.	Number of residences, occupied public buildings, food processing facilities, feed lots, farming or aquaculture operations downwind from 500 to 1000 meters from a Potential Candidate Site	11	2	0	6	0	6	1	6	0	6	20	0	0	6	0	6	0	6	0	6
		b.	Distance to emergency response facilities from a Potential Candidate Site	Fire 6 km Police 12 km Hospital 6.5 km	6	Fire 2 km Police 3 km Hospital 9 km	6	Fire 1 km Police 1.4 km Hospital 6.4 km	6	Fire 1 km Police 7.5 km Hospital 2.4 km	6	Fire 4.5 km Police 12 km Hospital 6 km	6	Fire 11 km Police 11 km Hospital 5 km	6	Fire 3.3 km Police 5 km Hospital 9.5 km	6	Fire 5 km Police 3.6 km Hospital 5 km	6	Fire 4.5 km Police 15 km Hospital 6.5 km	6	Fire 4.5 km Police 15 km Hospital 6.5 km	6
2	**Natural Environmental Considerations (possible high score of 6)**	a.	Number, extent and significance (i.e. Crown Forest, Woodland Improvement Area) of woodlots that would be cleared	significant (> 2 ha)	0	minimal	6	moderate (<2 ha)	2	significant (> 2 ha)	0	significant (> 2 ha)	0	significant (> 2 ha)	0	minimal	6	significant (> 2 ha)	0	none	6	none	6
		b.	Number, extent and significance of a permanent (year round flow) watercourse from 100 to 500 meters form the site	[illegible] watercourses and 2 lakes	0	3 watercourses	2	3 watercourses and 2 lakes	2	[illegible] watercourses and 3 lakes	0	3 watercourses and 1 lake	2	3 watercourses and 1 lake	2	3 watercourses and 1 lake	2	8 watercourses and within 1 km of Lingan Bay	0	2 watercourses and approx. 1 km from the ocean	2	0 watercourses and on ocean	6
		c.	Presence of Environmentally Significant Areas (as designated by federal, provincial or municipal authorities) within 500 meters of a Potential Candidate Site property line (i.e. watercourse protection areas, natural environmental areas, hazard lands)	1	4	0	6	1	4	1	4	1	4	1	4	2	2	2	2	0	6	0	6
		d	Designated natural resource areas within 500 meters of a Potential Candidate Site (i.e. Wildlife Management Areas, Wetlands Habitat and Endangered Species Habitat), and identified by appropriate government agencies	0	6	2	4	4	4	2	4	4	4	2	4	4	4	11	0	0	6	0	6
		e.	Vegetation, aquatic habitat, terrestrial wildlife habitat on site and within 500 meters	undisturbed natural vegetation, wetland habitat adjacent to reservoir, forested area	0	extensive disturbance, reclaimed mine site, adjacent watercourses (AMD), minimal natural vegetation	6	regen forest habitat, fragmented habitat, Inglis Lake located to the west of site, adjacent to industrial land use (south), and residential land use (west)	2	Extensive forest and wetland habitat, watercourses on the north side of site, multiple powerline corridors	0	Extensive forest habitat, adjacent to Kilkenny Lake, water supply area	0	Extensive forest and wetland habitat, a number of watercourses through site	0	Heavily disturbed site, previous industrial use, adjacent to Grand Lake	6	Extensive forest habitat, a number of watercourses through site, some wetland habitat	0	Heavily disturbed site, previous industrial use	6	Mix of shrubland coastal vegetation, undeveloped.	4
		f.	Presence and number of stream crossings and access routes	No existing access. Several stream crossings required	0	Existing access (upgrade required). Several stream crossings.	4	No existing access. One stream crossing required.	2	No existing access. One stream crossing required.	2	No existing access. One stream crossing required.	2	No existing access. One stream crossing required.	2	Existing access (no upgrade required). No stream crossings	6	No existing access. Several stream crossings required.	0	Existing access (no upgrade required). No stream crossings	6	No existing access. No stream crossings required.	4
		g.	Number of designated conservation areas or national, provincial, or municipal parks within 500 meters of a Potential Candidate Site property line	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6
		h.	Presence of surficial soil that has the potential to mitigate or contain potential spills	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2	fair (moderate to poorly drained soils)	2
		i.	Frequency of good dispersive conditions (based on data from Sydney airport)	good	4	good	4	good	4	good	4	good	4	good	4	good	4	good	4	good	4	good	4
		j.	Areas above an active or inactive shaft or tunneled mine or other areas of potential subsidence	none	6	adjacent to abandoned strip mine	4	none	6	none	6	none	6	none	6	none	6	none	6	moderate potential	4	moderate potential	4
3	**Social/Cultural Considerations (possible high score of 3)**	a.	Number of property ownerships required for the establishment of a Potential Candidate Site (private or public)	1 (Devco)	3	multiple	2	1 (CBRM)	3	1 (CBRM)	3	1 (Devco)	3	1 (Devco)	3	1 (Devco)	3	1 (Devco)	3	1 (Devco)	3	1 (Devco)	3
		b.	Number of buildings along the primary and secondary access roads to the Potential Candidate Site	9	3	362	1	249	2	513	0	9	3	9	3	311	1	339	1	506	0	500	0
		c.	Presence of historical, archaeological or architecturally significant features within 500 meters of a Potential Candidate Site property line based on relevant government agency input	none	3	none	3	none	3	none	3	none	3	none	3	none	3	none	3	none	3	historical battery, not considered significant	3
		d.	Type of other land uses within 500 meters of a Potential Candidate Site property line	none	3	none	3	none	3	none	3	none	3	none	3	industrial (being decommissioned)	3	transportation (rail)	2	industrial, Government offices	2	utility (coal fired power station)	3
		e.	Proximity to population concentrations	> 2 km from significant populated area	3	< 2 km from significant populated area	2	< 1 km from significant populated area	1	< 2 km from significant populated area	2	> 2 km from significant populated area	3	< 2 km from significant populated area	2	> 2 km from significant populated area	3	< 2 km from significant populated area	2	> 2 km from significant populated area	3	> 2 km from significant populated area	3
		f.	Number and type of community and recreational features between 500 and 1000 meters of a Potential Candidate Site property line and along primary and secondary access routes	0	3	0	3	1 baseball field	2	4 - baseball field, playground, park (2)	1	0	3	0	3	8 - baseball field, playground, park (3), tennis court, race track, golf course	0	10 - baseball field, playground, park (3), tennis court, driving range, sports club, golf course, school (2)	0	10 - baseball field, playground (2), park (2), tennis court, driving range, golf course, campground	0	10 - baseball field, playground (2), park (3), tennis court, driving range, golf course campground	0
4	**Economic/Financial Considerations (possible high score of 3)**	a.	Distance to a Potential Candidate Site from unrestricted (weight) roads, highways or active rail lines	< 1 (rail)	2	< 1 (road)	2	< 1 (road and rail)	3	< 1 (road)	2	< 1 (rail)	2	< 1 (rail)	2	< 1 (rail and road)	3	< 1 (road)	2	< 1 (rail and road)	3	< 1 (rail)	2
		b.	Distance from source of contaminated materials	9 km	1	~ 15.5 km	0	~3 km	3	7 km	1	~ 11 km	0	~13 km	0	~5 km	3	~ 10 km	1	~19 km	0	~20 km	0
		c.	Length of the primary access road requiring construction and/or improvement	~ 1500 m	0	~ 2000 m	0	<500m	3	~ 1000 m	1	~ 1500 m	0	~ 1500 m	0	None	3	~ 1500 m	0	None	3	<1000 m	2
		d	Transportation costs for materials and equipment	high	0	moderate	2	low	3	moderate	2	high	1	high	1	moderate	2	moderate	2	high	1	high	1
		e.	Estimated site acquisition cost	reasonable	3	moderate	2	reasonable	3	reasonable	3	reasonable	3	reasonable	3	reasonable	3	reasonable	3	reasonable	3	reasonable	3
5	**Technical Considerations (possible high score of 3)**	a.	Access available by road and/or rail	road	1	partial road	0	road and rail	3	road	1	rail only	0	rail only	0	road and rail	3	neither	0	road and rail	3	road	1
		b.	Total site area configuration. The site should be level with suitable foundation and surface area for the destruction units, support equipment and waste storage area. Appropriate access should exist for proper implementation of spill cleanup procedures	extensive site development required	0	extensive site development required	0	some site development required	2	extensive site development required, site may be [illegible]	0	extensive site development required	0	extensive site development required	0	minimal additional site development required	3	extensive site development required	0	minimal additional site development required	3	extensive site development required	0
			TOTAL SCORE		61		76		80		62		66		59		89		51		87		81
			RANK		8		5		4		7		6		9		1		10		2		3

Green	Very Good	Yellow	Fair
Blue	Good	Orange	Poor

TABLE 2.3 Level B Potential Candidate Site Evaluation

#	Criteria		Level II Criteria	Site 1 (Reservoir)		Site 2 (Airport)		Site 3 (Landfill)		Site 4 (Mira Road)		Site 5 (Kilkenny)	
				Description	Score	Description	Score	Description	Score	Description	Score	Description	Score
1	Public Health and Safety Considerations (possible high score of [illegible])	a	[illegible]	11	[illegible]	0	[illegible]	0	[illegible]	1	[illegible]	0	[illegible]
		b	[illegible]	Fire 6 km Police 12 km Hospital 6.5 km	[illegible]	Fire 7 km Police 3 km Hospital 9 km	[illegible]	Fire 3 km Police 3.4 km Hospital 6.4 km	[illegible]	Fire 3 km Police 7.5 km Hospital 2.4 km	[illegible]	Fire 4.5 km Police 13 km Hospital 4 km	[illegible]
2	Natural Environmental Considerations (possible high score of [illegible])	a	[illegible]	significant (> 2 ha)	[illegible]	minimal	[illegible]	moderate (< 2 ha)	[illegible]	significant (> 2 ha)	[illegible]	significant (> 2 ha)	[illegible]
		b	[illegible]	2 watercourses and 5 lakes	[illegible]	1 watercourse	[illegible]	1 watercourse and 2 lakes	[illegible]	4 watercourses and 3 lakes	[illegible]	1 watercourse and 1 lake	[illegible]
		c	[illegible]	1	[illegible]	0	[illegible]	1	[illegible]	1	[illegible]	1	[illegible]
		d	[illegible]	0	[illegible]	2	[illegible]	4	[illegible]	2	[illegible]	4	[illegible]
		e	[illegible]	undisturbed natural vegetation, wetland habitat adjacent to reservoir, forested area	[illegible]	extensive disturbance, reclaimed mine site, adjacent watercourses (AMD), minimal natural vegetation	[illegible]	[illegible] habitat, fragmented habitat, [illegible] Lake located to the west of site, adjacent to industrial land use [illegible] and residential land use [illegible]	[illegible]	Extensive forest and wetland habitat, watercourses on the south side of site, multiple powerline corridors	[illegible]	Extensive forest habitat, adjacent to Kilkenny Lake, water supply area	[illegible]
		f	[illegible]	No existing access. Several stream crossings required	[illegible]	Existing access (upgrade required). Several stream crossings	[illegible]	No existing access. One stream crossing required	[illegible]	No existing access. One stream crossing required	[illegible]	No existing access. One stream crossing required	[illegible]
		g	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]
		h	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]
		i	[illegible]	good	[illegible]	good	[illegible]	good	[illegible]	good	[illegible]	good	[illegible]
		j	[illegible]	none	[illegible]	adjacent to abandoned strip mine	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]
3	Social/Cultural Considerations (possible high score of [illegible])	a	[illegible]	1 (Devco)	[illegible]	multiple	[illegible]	1 (CBRM)	[illegible]	1 (CBRM)	[illegible]	1 (Devco)	[illegible]
		b	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	513	[illegible]	0	[illegible]
		c	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]
		d	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]
		e	[illegible]	> 2 km from significant populated area	[illegible]	< 2 km from significant populated area	[illegible]	< 2 km from significant populated area	[illegible]	< 2 km from significant populated area	[illegible]	> 2 km from significant populated area	[illegible]
		f	[illegible]	0	[illegible]	0	[illegible]	1 baseball field	[illegible]	3 - baseball field, playground, park (1)	[illegible]	0	[illegible]
4	Economic/Financial Considerations (possible high score of [illegible])	a	[illegible]	< 1 (rail)	[illegible]	< 1 (road)	[illegible]	< 1 (road and rail)	[illegible]	< 1 (road)	[illegible]	< 1 (rail)	[illegible]
		b	[illegible]	9 km	[illegible]	~ 13.5 km	[illegible]	~ 3 km	[illegible]	7 km	[illegible]	~ 11 km	[illegible]
		c	[illegible]	~ 1500 m	[illegible]	~ 2000 m	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	~ 1500 m	[illegible]
		d	[illegible]	high	[illegible]	moderate	[illegible]	low	[illegible]	moderate	[illegible]	high	[illegible]
		e	[illegible]	reasonable	[illegible]	moderate	[illegible]	reasonable	[illegible]	reasonable	[illegible]	reasonable	[illegible]
5	Technical Considerations (possible high score of [illegible])	a	[illegible]	road	[illegible]	partial road	[illegible]	road and rail	[illegible]	road	[illegible]	rail only	[illegible]
		b	[illegible]	extensive site development required	[illegible]	extensive site development required	[illegible]	some site development required	[illegible]	extensive site development required, site may be very wet	[illegible]	extensive site development required	[illegible]
			TOTAL SCORE		61		76		80		62		66
			RANK		8		5		4		7		6

#	Criteria		Level II Criteria	Site 6 (Scotchtown)		Site 7 (VJ Wash Plant)		Site 8 (Crossroads)		Site 9 (Phalen Mine Site)		Site 10 (North Head)	
				Description	Score	Description	Score	Description	Score	Description	Score	Description	Score
1	Public Health and Safety Considerations (possible high score of [illegible])	a	[illegible]	20	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]
		b	[illegible]	Fire 11 km Police 11 km Hospital 5 km	[illegible]	Fire 3.5 km Police 8 km Hospital 9.8 km	[illegible]	Fire 3 km Police 3.6 km Hospital 5 km	[illegible]	Fire 4.6 km Police 18 km Hospital 6.1 km	[illegible]	Fire 4.5 km Police 15 km Hospital 6.4 km	[illegible]
2	Natural Environmental Considerations (possible high score of [illegible])	a	[illegible]	significant (> 2 ha)	[illegible]	minimal	[illegible]	significant (> 2 ha)	[illegible]	none	[illegible]	[illegible]	[illegible]
		b	[illegible]	1 watercourse and 1 lake	[illegible]	1 watercourse and 1 lake	[illegible]	5 watercourses and within 1 km of Lingan Bay	[illegible]	2 watercourses and approx. 1 km from the ocean	[illegible]	0 watercourses and [illegible]	[illegible]
		c	[illegible]	1	[illegible]	[illegible]	[illegible]	2	[illegible]	0	[illegible]	0	[illegible]
		d	[illegible]	2	[illegible]	4	[illegible]	11	[illegible]	0	[illegible]	0	[illegible]
		e	[illegible]	Extensive forest and wetland habitat, a number of watercourses through site	[illegible]	Heavily disturbed site, previous industrial use, adjacent to Grand Lake	[illegible]	Extensive forest habitat, a number of watercourses through site, some wetland habitat	[illegible]	Heavily disturbed site, previous industrial use	[illegible]	Mix of shrubland coastal vegetation, undeveloped	[illegible]
		f	[illegible]	No existing access. One stream crossing required	[illegible]	Existing access (no upgrade required). No stream crossings	[illegible]	No existing access. Several stream crossings required	[illegible]	Existing access (no upgrade required). No stream crossings	[illegible]	No existing access. No stream crossings required	[illegible]
		g	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]	0	[illegible]
		h	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]	fair (moderate) to poorly drained soils	[illegible]
		i	[illegible]	good	[illegible]	good	[illegible]	good	[illegible]	good	[illegible]	good	[illegible]
		j	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]	moderate potential	[illegible]	moderate potential	[illegible]
3	Social/Cultural Considerations (possible high score of [illegible])	a	[illegible]	1 (Devco)	[illegible]	1 (Devco)	[illegible]	1 (Devco)	[illegible]	1 (Devco)	[illegible]	2 (Devco)	[illegible]
		b	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		c	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]	none	[illegible]	historical battery, not considered significant	[illegible]
		d	[illegible]	none	[illegible]	[illegible]	[illegible]	transportation (rail)	[illegible]	Industrial, Government offices	[illegible]	[illegible]	[illegible]
		e	[illegible]	< 2 km from significant populated area	[illegible]	> 2 km from significant populated area	[illegible]	< 2 km from significant populated area	[illegible]	> 2 km from significant populated area	[illegible]	> 2 km from significant populated area	[illegible]
		f	[illegible]	0	[illegible]	5 - baseball field, playground, park (1), tennis court, race track, golf course	[illegible]	10 - baseball field, playground, park (3), tennis court, driving range, sports club, golf course, school (2)	[illegible]	10 - baseball field, playground (2), park (3), tennis court, driving range, golf course, campground	[illegible]	10 - baseball field, playground (2), park (3), tennis court, driving range, golf course, campground	[illegible]
4	Economic/Financial Considerations (possible high score of [illegible])	a	[illegible]	< 1 (rail)	[illegible]	< 1 (rail and road)	[illegible]	< 1 (road)	[illegible]	< 1 (rail and road)	[illegible]	< 1 (rail)	[illegible]
		b	[illegible]	~13 km	[illegible]	~ 3 km	[illegible]	~ 10 km	[illegible]	~19 km	[illegible]	~19 km	[illegible]
		c	[illegible]	~ 1500 m	[illegible]	None	[illegible]	~ 1500 m	[illegible]	None	[illegible]	< 1000 m	[illegible]
		d	[illegible]	high	[illegible]	moderate	[illegible]	moderate	[illegible]	high	[illegible]	high	[illegible]
		e	[illegible]	reasonable	[illegible]	reasonable	[illegible]	reasonable	[illegible]	reasonable	[illegible]	reasonable	[illegible]
5	Technical Considerations (possible high score of [illegible])	a	[illegible]	rail only	[illegible]	road and rail	[illegible]	neither	[illegible]	road and rail	[illegible]	road	[illegible]
		b	[illegible]	extensive site development required	[illegible]	minimal additional site development required	[illegible]	extensive site development required	[illegible]	minimal additional site development required	[illegible]	extensive site development required	[illegible]
			TOTAL SCORE		59		89		51		87		81
			RANK		9		1		10		2		3

Green	[illegible]	Yellow	Fair
Blue	Good	Orange	Poor

Blank

based, in part on an inter-comparison of the sites with respect to the criteria. For example, a site with no buildings on its primary access road rated better (e.g., very good) than a site with 10 buildings on its primary access road (e.g., good), which rated better than a site with 100 buildings on its access road (e.g., fair), which rated better than a site with 1000 buildings on its access road (e.g., poor).

A scoring system was developed to judge the degree to which each site met the criteria. The scores allocated to each criteria are described below:

- Very Good – 3 points (denoted as green in Table 2.3);
- Good – 2 points (denoted as blue in Table 2.3);
- Fair – 1 point (denoted as yellow in Table 2.3); and
- Poor – 0 points (denoted as orange in Table 2.3).

Public health and safety and environmental considerations were given the most emphasis (i.e., High Priority) in selecting the candidate sites and were weighted accordingly, by doubling the score (i.e., very good – 6 points, good – 4 points, fair – 2 points, poor – 0 points). All other criteria were given a lesser priority and were not weighted in the evaluation.

The 4 Candidate Sites that were selected, based on the Level II evaluation included:

- Site 7: CBDC land at the site of the former Victoria Junction Wash Plant, off Grand Lake Road (see Figure 2.3);
- Site 9: CBDC land at the site of the former Phalen Colliery in Lingan (see Figure 2.4); and
- Site 10: CBDC land located at North Head in Lingan (see Figure 2.5);
- Site 3: CBRM land that is located adjacent to the municipal incinerator and landfill (see Figure 2.6).

The suggested areas for siting of a temporary incinerator on each of the properties are shown on the figures.

4.0 SUMMARY AND CONCLUSION

AMEC was tasked to develop and apply criteria to determine acceptable candidate sites for a temporary incinerator to be used during the remediation of the Sydney Tar Ponds and Coke Ovens Sites.

Two levels of criteria were developed that progressively narrowed the available properties to 4 candidate sites:

- Site 7: CBDC property at the site of the former Victoria Junction Wash Plant, off Grand Lake Road;
- Site 9: CBDC property at the site of the former Phalen Colliery in Lingan;
- Site 10: CBDC property located at North Head in Lingan; and
- Site 3: CBRM land that is located adjacent to the municipal incinerator and landfill.

Based on the scoring of the 10 potential sites, using Level II criteria, it has been determined that Site 7, Victoria Junction (VJ) Wash Plant, is the preferred site for the location of a temporary incinerator facility. The top 3 other acceptable sites, based on the scoring of the Level II criteria were Site 9 (Phalen), Site 10 (North Head), and Site 3 (Landfill), respectively.

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APPENDIX A

Figures

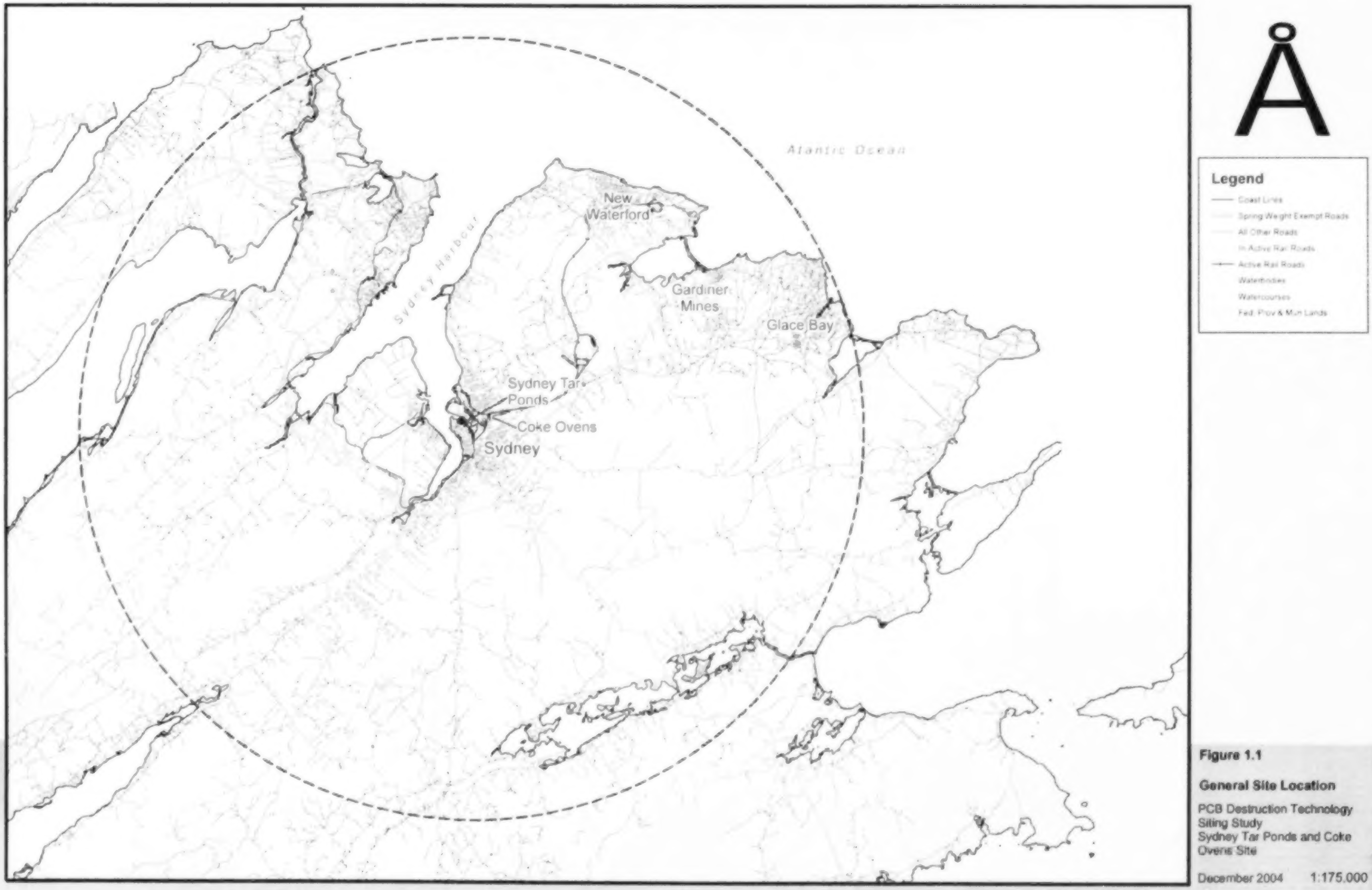
Atlantic Ocean
New Waterford
Gardiner Mines
Glace Bay
Sydney Harbour
Sydney Tar Ponds
Coke Ovens
Sydney
Legend
Coast Lines
Spring Weight Exempt Roads
All Other Roads
In Active Rail Roads
Active Rail Roads
Waterbodies
Watercourses
Fed. Prov & Mun Lands

Figure 1.1

General Site Location

PCB Destruction Technology
Siting Study
Sydney Tar Ponds and Coke
Ovens Site

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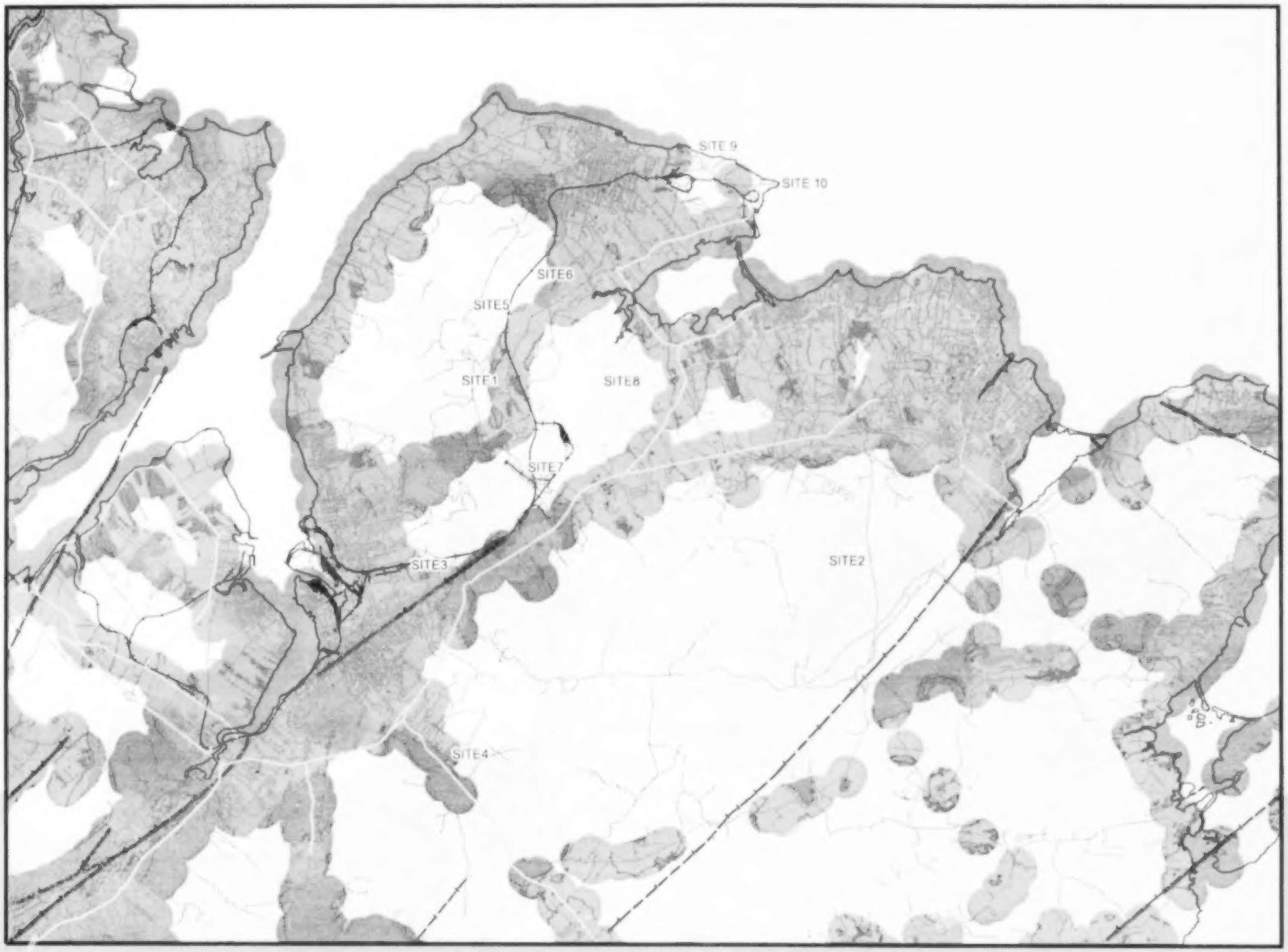
SITE 9
SITE 10
SITE6
SITE5
SITE1
SITE8
SITE7
SITE3
SITE2
SITE4
Legend
Sites
Waterbodies
Watercourses
Coast Lines
Spring Weight Exempt Roads
All Other Roads
In-Active Rail Roads
Active Rail Roads
Fault Constraints
Watersheds Constraints
Agricultural Constraints
Landuse Contraints
Landuse Contraint Facilities
Fed & Prov DNR Constraints
Landuse Structure Buffer (50% Transparent)
Water Course Buffer (50% Transparent)
DNR Constraint Buffer (50% Transparent)
Watershed Buffer (50% Transparent)
Fault Buffer (50% Transparent)
Landuse Buffer (50% Transparent)

Figure 2.1

Constraint Map

PCB Destruction Technology
Siting Study
Sydney Tar Ponds and Coke
Ovens Site

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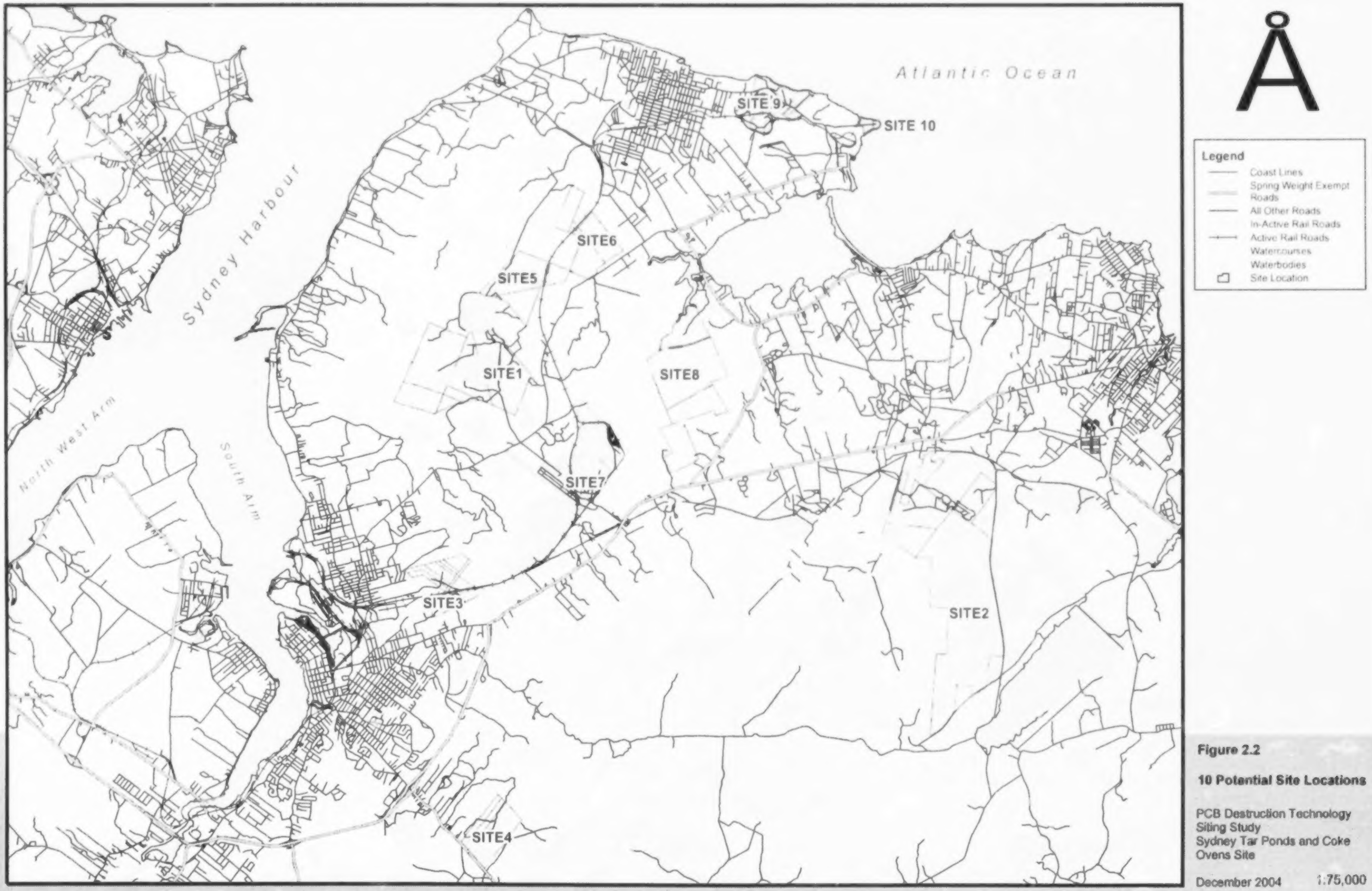
Atlantic Ocean
Sydney Harbour
North West Arm
South Arm
SITE 9
SITE 10
SITE6
SITE5
SITE1
SITE8
SITE7
SITE3
SITE2
SITE4
Legend
Coast Lines
Spring Weight Exempt Roads
All Other Roads
In-Active Rail Roads
Active Rail Roads
Watercourses
Waterbodies
Site Location

Figure 2.2

10 Potential Site Locations

PCB Destruction Technology
Siting Study
Sydney Tar Ponds and Coke
Ovens Site

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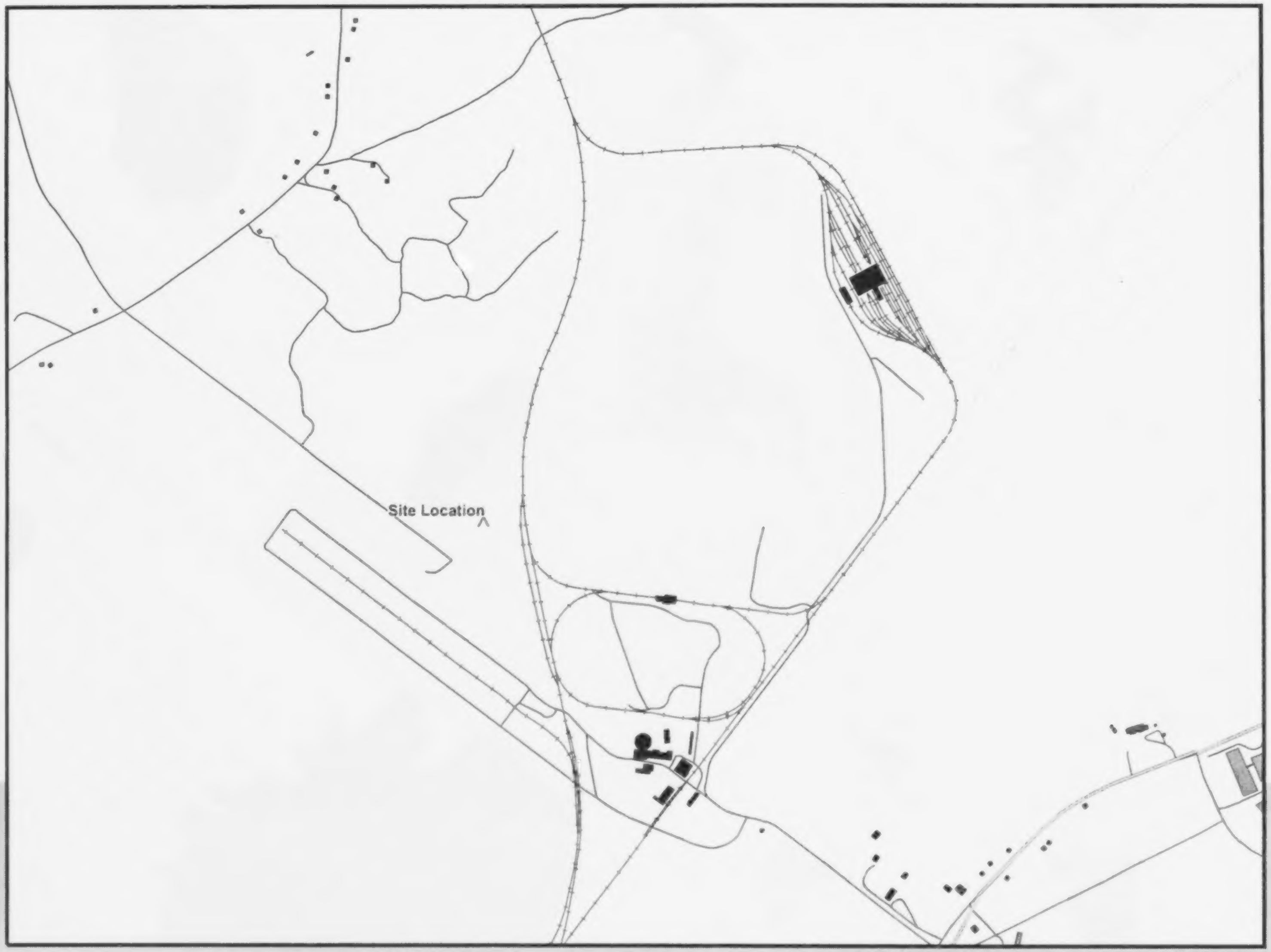
Site Location
Legend
Site Location
All Landuse Structures
Agricultural
Agriculture
Commercial
Education
Education - Vacant
Forestry
Government
Hall
Health Care
Industrial
Industrial - Vacant
Institutional
Mixed Use
Public Protection
Recreation
Religious
Residential
Residential Seasonal
Utility
Coast Lines
Spring Weight Exempt Roads
All Other Roads
In-Active Rail Roads
Active Rail Roads
Watercourses
Waterbodies
Properties

Figure 2.3

V.J. Wash Plant
Site 7

PCB Destruction Technology
Siting Study
Sydney Tar Ponds and Coke
Ovens Site

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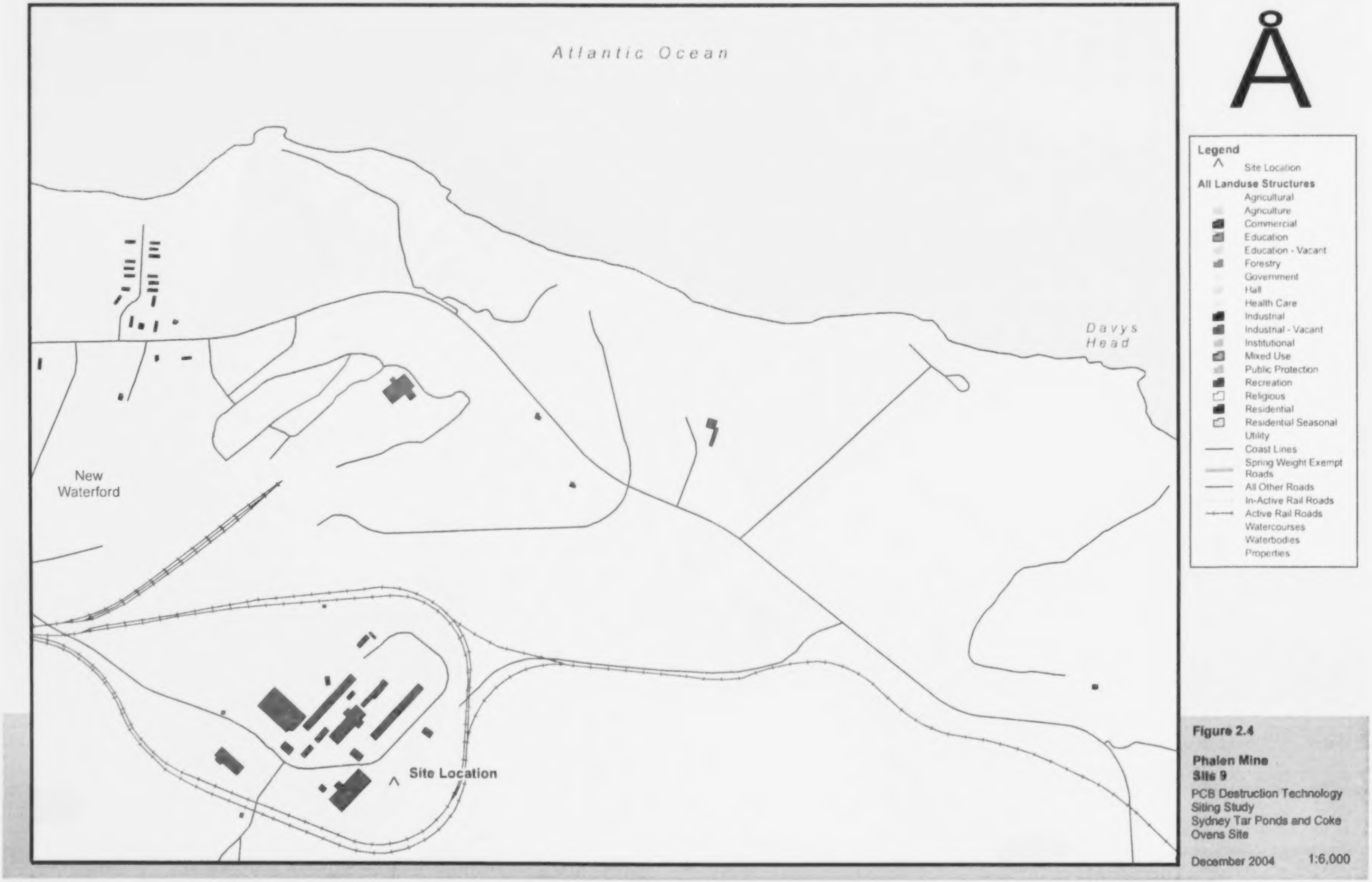
Atlantic Ocean
Davys Head
New Waterford
^ Site Location
Legend
^ Site Location
All Landuse Structures
Agricultural
Agriculture
Commercial
Education
Education - Vacant
Forestry
Government
Hall
Health Care
Industrial
Industrial - Vacant
Institutional
Mixed Use
Public Protection
Recreation
Religious
Residential
Residential Seasonal
Utility
Coast Lines
Spring Weight Exempt Roads
All Other Roads
In-Active Rail Roads
Active Rail Roads
Watercourses
Waterbodies
Properties

Figure 2.4

Phalen Mine
Site 9
PCB Destruction Technology
Siting Study
Sydney Tar Ponds and Coke
Ovens Site

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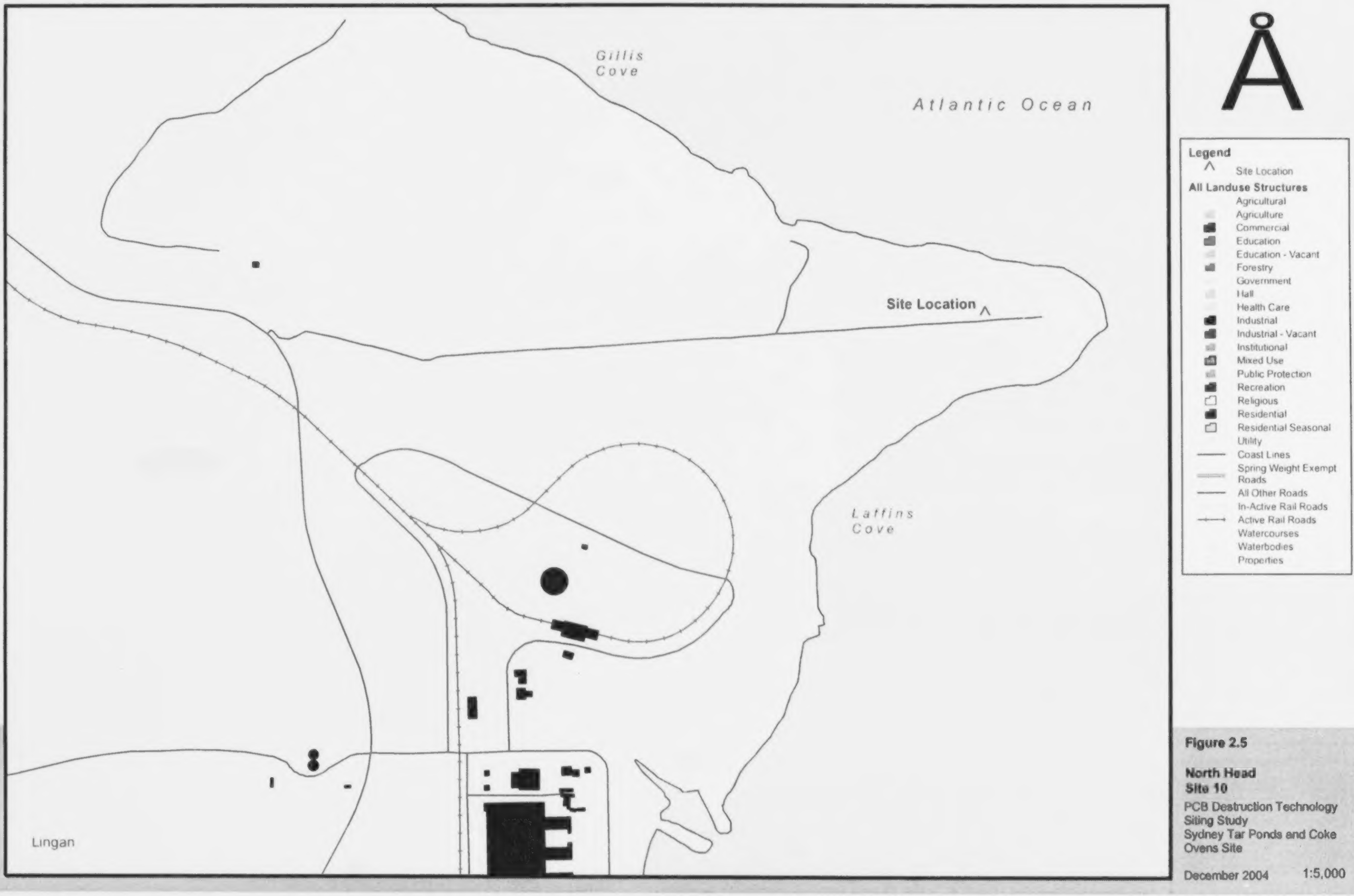
Gillis Cove
Atlantic Ocean
Site Location
Laffins Cove
Lingan
Legend
Site Location
All Landuse Structures
Agricultural
Agriculture
Commercial
Education
Education - Vacant
Forestry
Government
Hall
Health Care
Industrial
Industrial - Vacant
Institutional
Mixed Use
Public Protection
Recreation
Religious
Residential
Residential Seasonal
Utility
Coast Lines
Spring Weight Exempt Roads
All Other Roads
In-Active Rail Roads
Active Rail Roads
Watercourses
Waterbodies
Properties

Figure 2.5

North Head
Site 10

PCB Destruction Technology
Siting Study
Sydney Tar Ponds and Coke
Ovens Site

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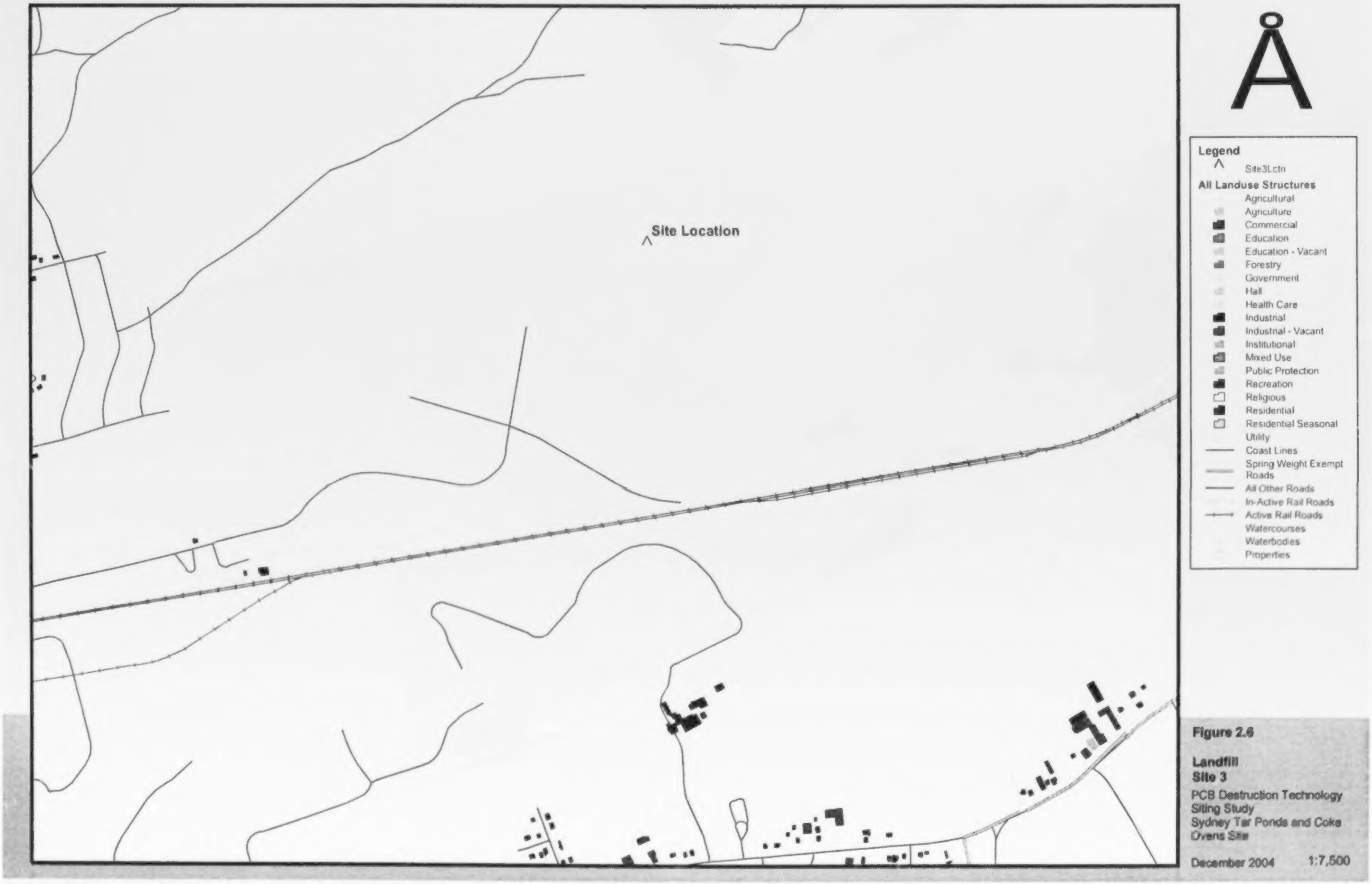
Site Location
Legend
Site3Lctn
All Landuse Structures
Agricultural
Agriculture
Commercial
Education
Education - Vacant
Forestry
Government
Hall
Health Care
Industrial
Industrial - Vacant
Institutional
Mixed Use
Public Protection
Recreation
Religious
Residential
Residential Seasonal
Utility
Coast Lines
Spring Weight Exempt Roads
All Other Roads
In-Active Rail Roads
Active Rail Roads
Watercourses
Waterbodies
Properties

Figure 2.6

Landfill
Site 3
PCB Destruction Technology
Siting Study
Sydney Tar Ponds and Coke
Ovens Site

December 2004 1:7,500

APPENDIX C

Environmental Management Plan

REMEDIATION OF THE SYDNEY TAR PONDS AND COKE OVENS SITES

ENVIRONMENTAL MANAGEMENT PLAN

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December 2004

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1.0 INTRODUCTION

The Government of Canada and the Government of Nova Scotia, through the Sydney Tar Ponds Agency ("Proponents"), intend to remediate (i.e., cleanup) the Sydney Tar Ponds and Coke Ovens sites located in Cape Breton Regional Municipality (CBRM), Nova Scotia (the "Project"). Figure 1.1 shows the general features of the proposed Project area.

Remediation of the sites will reduce the ecological and human health risks from the existing contamination, and will result in properties suitable for future development.

1.1 PURPOSE

To ensure the protection of the environment this Environmental Management Plan ("EMP") has been developed to communicate to all project participants and stakeholders the commitment and efforts to be undertaken to prevent, manage and minimize any potential environmental impacts related to the Project. The EMP is the principle vehicle for ensuring that mitigation is implemented as directed by all applicable regulatory requirements and provides an opportunity to outline responsible construction practices.

This EMP was developed as a guidance document in order to demonstrate and ensure due diligence is constantly maintained for any Project activities undertaken by the Sydney Tar Ponds Agency ("STPA").

The purpose of this EMP is to:

- Support the Project's commitments to minimize environmental effects;
- Document environmental concerns and appropriate protection measures; and
- Provide instructions to relevant project personnel regarding procedures for protecting the environment and minimizing environmental effects, thereby supporting the project goal of zero incidents.

The Project will involve a wide range of activities necessitating the implementation of remedial options that will be developed as the Project proceeds. All mitigation that will be recommended in the EIA, as well as any regulatory requirements, or conditions of permits/approvals, will be implemented via the mechanisms outlined in the EMP. It also provides implementation guidelines to help ensure compliance with the mitigation, monitoring, and follow-up commitments and requirements identified through the environmental assessment.

1.2 ENVIRONMENTAL POLICY AND GUIDING PRINCIPLES

The EMP is based on three fundamentals, which are:

- Compliance with legislative requirements and to all environmental regulations;
- Adherence to the Proponent's own guidelines, practices and procedures; and
- Conformity with the best management practices and industry standards.

It should also be recognized that the EMP is a dynamic "living" document that will continuously require revision due to site activities, changes in legislation, new technological approaches, etc. It will be incumbent on the Proponents to ensure that routine reviews of the document are completed and that the contents remain current over the entire length of the Remediation

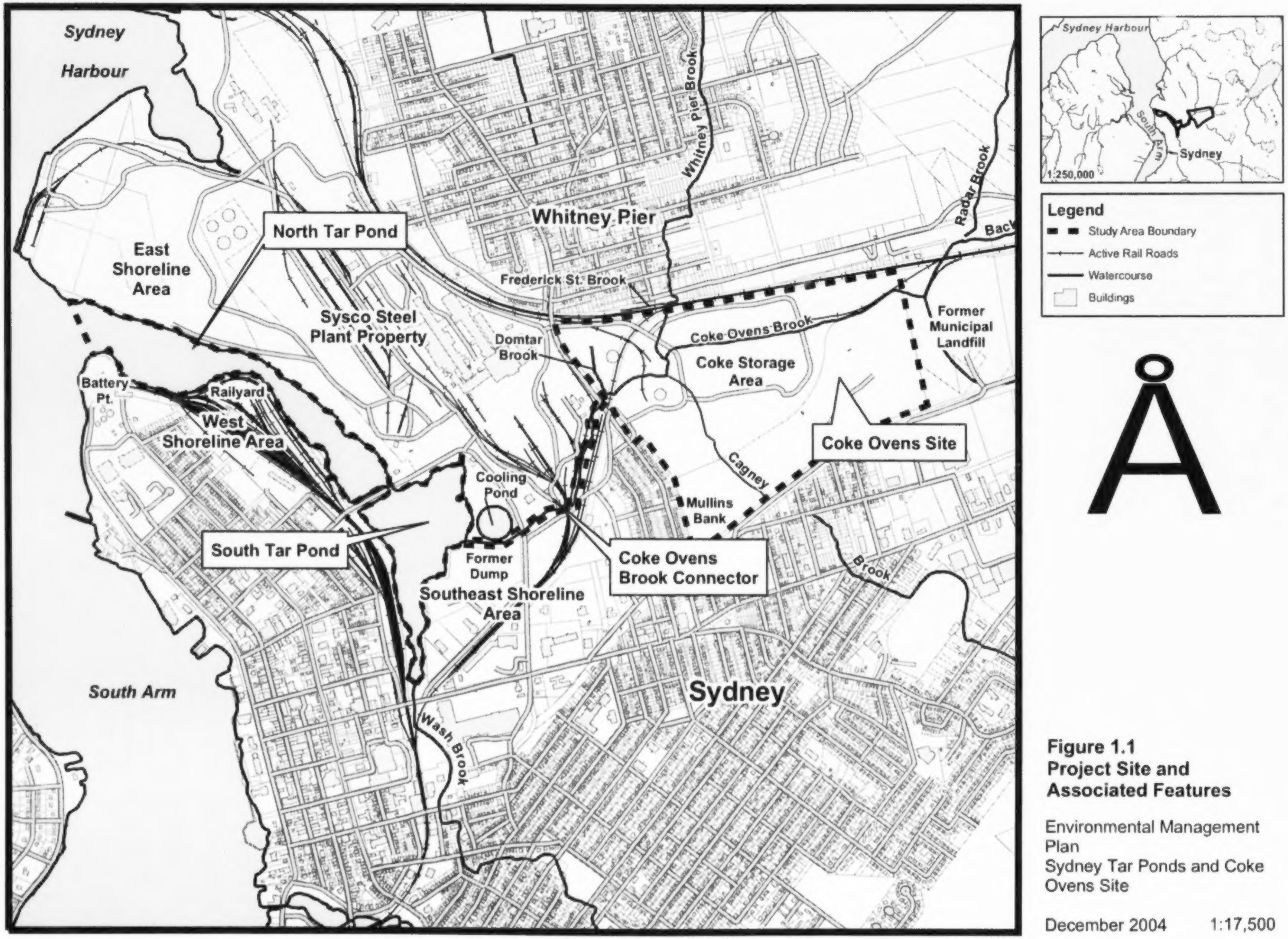
Sydney Harbour
East Shoreline Area
North Tar Pond
Sysco Steel Plant Property
Whitney Pier
Whitney Pier Brook
Radar Brook
Back
Frederick St. Brook
Domtar Brook
Coke Ovens Brook
Coke Storage Area
Former Municipal Landfill
Coke Ovens Site
Cagney
Mullins Bank
Battery Pt.
Railyard
West Shoreline Area
Cooling Pond
South Tar Pond
Former Dump
Southeast Shoreline Area
Coke Ovens Brook Connector
Brook
South Arm
Sydney
Wash Brook
Sydney Harbour
South Arm
Sydney
1:250,000
Legend
Study Area Boundary
Active Rail Roads
Watercourse
Buildings

Figure 1.1
Project Site and Associated Features

Environmental Management Plan
Sydney Tar Ponds and Coke Ovens Site

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Project and beyond. Modifications to existing documented protocols may be required to suit particular applications and conditions as they are identified.

1.3 ROLES AND RESPONSIBILITIES

For the success of any EMP, it is important that all participants understand their roles and responsibilities, as they pertain to environmental protection. The following is an outline of the management structure associated with the Project, and the responsibilities associated with the various positions. As the Project evolves the management structure may be altered, and responsibilities may be added or taken away from these positions and allocated to others. In addition, field specific roles and responsibilities shall be outlined in more detailed site specific protection plans (see Section 5.0) as they are developed.

STPA Chairman and Chief Executive Officer

The STPA Chairman and Chief Executive Officer will bear overall accountability for ensuring that the environmental management plan is in effect and adequately resourced.

STPA Project Manager

The STPA Project Manager will be responsible for the day-to-day implementation of the environmental management plan. This will include having mechanisms in place to ensure that the environmental policies and procedures are being adhered to by contractors and by staff engaged on the project.

Safety, Health and Environmental Coordinator

STPA will appoint a Safety, Health and Environmental Coordinator who will have responsibility for safety, health and environmental management. The following functions are required to fulfil this responsibility:

- Coordinate all safety, health and environmental management functions;
- Report on safety, health and environmental matters to the STPA Project Manager;
- Monitor compliance with relevant safety, health and environmental standards;
- Ensure all project participants have received the required training and any refresher training programs throughout the duration of the Project;
- Document all training programs and certifications; and
- Act as a spokesperson on safety, health and environmental issues.

Contractors

All contractors and subcontractors working on the site will be responsible for implementing, enforcing and maintaining their activities in accordance with the EMP for the duration of their contractual activities at the site. Each contractor and subcontractor will designate a person who will be responsible for compliance with the EMP. The contractor/subcontractor will ensure that his designated environmental coordinator has appropriate training.

Other Staff

All STPA staff will have a responsibility to comply with this EMP.

2.0 BACKGROUND

Located in the heart of the CBRM, the landscape of the Muggah Creek Watershed and its estuary includes a recently closed steel making operation, the remains of a coke production facility, a rail yard, and a number of active and abandoned waste material dumps.

Many of the production activities associated with the early coal and steel industry used raw materials, or produced wastes. Generic non-site specific studies have shown that these materials and chemicals can cause adverse effects for human health and the environment. In general, during these earlier times when the coal and steel industry was prospering, little was known of the negative effects of industrial emissions, which was considered to be a necessary by-product of prosperity.

The industrial by-products of the Sydney coke production operations included coal tar, ammonia, sulphur, light hydrocarbons (benzene, xylene, toluene), and polycyclic aromatic hydrocarbons (PAHs). In the early years of coke production, the contribution of contaminants to the environment was reduced through the internal recycling and recovery of these by-products. As the demand for these materials diminished for these processes, recycling and recovery operations were no longer economically viable. Formerly valuable by-products became waste materials and were allowed either to accumulate in unsecured storage areas at the plant site, or were deposited directly onto the soil, or into site watercourses. As a result of these activities, contaminants entrained in the raw materials and wastes are now present in the soils and groundwater of the Coke Ovens site, and in the waters and sediments of the Tar Ponds, Coke Oven Brook, Muggah Creek and Sydney Harbour.

The environment of Muggah Creek and Sydney were also impacted by the by-products of the steel making process, which included huge quantities of the relatively inert waste material known as slag. Over the last century of operation of the steel plant, slag and waste iron were deposited as infill material along the northeastern shoreline of the Muggah Creek estuary and Sydney Harbour. Over time the infilling operations encroached upon the former salt marsh and greatly changed the configuration of the natural shoreline. Other sources of contaminants associated with the coal and steel industry that may have impacted upon the Tar Ponds include the raw coal and coke product, flue dust from the blast furnaces and ovens, coal tars, sulphur (from the sulphuric acid plant), and miscellaneous waste water effluents.

The steel and coke industry was not the only industry operating in this area of Sydney. There was, for example, a coal tar plant, a cement plant, asphalt paving company, a fuel gas and oil company, metal processors, and a brick manufacturing company located in or in proximity to this area. Any or all of these operations may also have contributed to the contaminants in the area's soils, sediments, surface and groundwater, and air.

Environmental contamination of the Muggah Creek watershed in and around the area of former steel and coke making operations is known to be extensive and complex. Government and community efforts towards the cleanup of and remediation of impacted lands and water within the watershed have focused primarily on four areas (JAG, 1998a):

- the North and South Ponds of the Muggah Creek (the Tar Ponds);
- the former Coke Ovens site;
- the Coke Oven Brook Connector (a tributary to Muggah Creek); and
- the former municipal landfill.

This area, including the Tar Ponds and Coke Ovens sites, has been referred to as one of the worst contaminated sites in Canada (JAG, 1998a).

3.0 SCOPE OF THE PROJECT

The scope of the Project will consist of the various undertakings proposed by the proponents to be carried out in relation to the physical works and activities of the Project. This will include the specific construction, operation and decommissioning components of the Project. The specific components of the remediation of the Tar Ponds and Coke Ovens sites are summarized in Table 3.1. More detailed information regarding the various components of the Project can be found in the associated Project Description Report (AMEC 2004).

TABLE 3.1 Proposed Remediation Program

Activity		Tar Ponds Site	Coke Ovens Site
1.	Control Water	Construct watercourse diversion channels to redirect surface water flowing through the Tar Ponds. This will isolate brooks and streams from contaminated Tar Pond sediments.	Reroute groundwater and surface water flowing through the site to minimize water contact with contaminants.
2.	Remove and Destroy Selected Contaminants	Remove and destroy 120,000 tonnes (92,000 m^3) of sediment containing PCB material in an approved temporary PCB incinerator that will be constructed offsite in Industrial Cape Breton.	Remove and destroy 1,300 tonnes (1,000 m^3) of PAH contaminated sediment from Coke Oven Brook and 25,000 tonnes (12,500 m^3) of PAH contaminated material from the in-ground Tar Cell in an approved temporary incinerator that will be constructed offsite in Industrial Cape Breton.
3.	Treat Selected Contaminants In-place	Solidify and stabilize, in-place, the top 1 to 2 m of remaining sediment with a binder (such as Portland cement) using on-site auger or grout injection systems.	Treat, in-place, 253,700 tonnes (128,800 m^3) of remaining contaminated surface soils using bioremediation. Landfarming of the top 0.5 m of contaminated soil will be used to promote biological breakdown of contaminants in surface soils.
4.	Contain Residual Contaminants	Install a containment system designed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability barrier walls installed at various locations around the perimeter of the Tar Ponds and an engineered cap.	Install a containment system designed to reduce human and ecological exposure to contaminants and to prevent the movement of contaminants off-site. The containment system will consist of low permeability vertical walls installed at various locations around the perimeter of the Coke Ovens site and a soil cover designed to facilitate future site use(s).
5.	Site Surface Restoration and Landscaping	Site restoration and landscaping will be compatible with the natural surroundings and future use.	Site restoration and landscaping will be compatible with the natural surroundings and future use.
6.	Long-term Monitoring and Maintenance Plan	Monitor air quality, water quality and the performance of the containment system after completion of the project.	Monitor air quality, water quality and the performance of the containment system after completion of the project.

The remediation of the Tar Ponds and Coke Ovens sites will use technologies that have been demonstrated to be safe and effective on similar contaminated sites.

The worst (high levels of PCBs and PAHs) contaminants will be removed and safely destroyed using high temperature incineration. The licensed and approved temporary incinerator will be located offsite, within 20 km of the Tar Ponds and Coke Ovens sites, in industrial Cape Breton. Materials to be incinerated include 120,000 tonnes (92,000 m^3) of sediment containing PCB materials from the Tar Ponds and 26,300 tonnes (13,500 m^3) of PAH contaminated sediment from the Coke Ovens site (Coke Oven Brook sediment and Tar Cell contents).

The remaining contaminants will be treated in place. The remaining sediment in the Tar Ponds will be treated using solidification and stabilization. The remaining contaminated soil at the Coke Ovens site will be treated using landfarming, a form of bioremediation.

Both sites will then be encapsulated using engineered containment systems designed to prevent human and environmental exposure to contaminants, and to prevent the movement of contaminants off site. Containment at the Tar Ponds will consist of impervious vertical walls installed at various locations around the edges of the Tar Ponds, and an engineered cover consisting of a semi-impervious, reinforced, multi-layered soil barrier designed to limit water penetration and facilitate future site uses. Containment at the Coke Ovens site will include impervious vertical walls installed at various locations around the perimeter of the site, and a covering of soil designed to facilitate future uses of the site.

Final restoration and landscaping of both sites will be compatible with the natural surroundings and future use.

Containment systems require long term monitoring to ensure their continued effectiveness. The remediation plan includes provisions for long term monitoring of air quality, water quality, and the performance of the containment system, and long-term maintenance of the sites.

4.0 REGULATORY CONTEXT

The Project is regulated under various federal and provincial legislation as well as related policies and/or guidelines and industry codes of practice. These requirements, in Canada and Nova Scotia, have evolved over a number of years to increasingly provide environmental protection and sustainable development and ensure that environmental implications of projects are considered during the planning phase.

Other legal requirements related to environmental management of the Project include any terms and conditions of regulatory approval such as those arising from the Environmental Impact Assessment process and other approvals required to construct and operate the Project. Typically these terms and conditions would include commitments made by the proponent (e.g., mitigation and monitoring measures) as well as those specified by regulatory approval agencies. All of these requirements will obligate the proponent throughout the life of the Project and, to a significant extent, direct the course of environmental management planning.

All persons working on the Project will therefore receive environmental orientation training, which will include awareness of applicable legislation/guidelines to ensure protection of the environment and compliance with applicable legislation (refer to Section 8 for more information on training).

The following tables provide an overview of the regulatory requirements of the Project. While this is not intended to be an exhaustive list of pertinent federal and provincial legislation and policies, it does provide an overview of key regulatory requirements for Project planning and implementation. A refined list, incorporating all regulatory requirements, including terms and conditions, will be incorporated into the final EMP and updated as necessary during maintenance of the EMP document.

4.1 PERMITS AND APPROVALS SCHEDULE

When it has been determined that the Project is unlikely to result in significant adverse environmental effects, the federal responsible authorities and provincial government are in a position to support the Project, the Proponent can move forward with applications for the relevant permits and authorizations required for the Project. As noted in Tables 4.1 and 4.2, many of these approvals are required prior to start of construction. For example, approvals required from NSEL under the Activities Designation Regulations (e.g., Industrial and Water Approvals) can take up to 60 days to process.

The regulatory approval schedule will be incorporated into the overall planning schedule for the Project to ensure the necessary permits and approvals are obtained prior to construction and/or operation as required and all applicable environmental control measures are in place prior to initiating activities that otherwise could result in adverse environmental effects.

TABLE 4.1 Summary of Applicable Federal Approvals, Permits and Authorizations

Permit/Approval	Legislation	Responsible Government Department or Agency	Information	Potential Project Related Activities
Environmental Assessment Approval (Federal)	Canadian Environmental Assessment Act (CEAA)	Canadian Environmental Assessment Agency Public Works and Government Services Canada (PWGSC) (Responsible Authority) Other potential Responsible Authorities may include Department of Fisheries and Oceans and Environment Canada	Required for projects meeting relevant federal criteria. Environmental Assessment process has not yet been finalized and may involve harmonized process with provincial government. Specific triggers for CEAA assessment include: Any aspect of project implementation that uses Federal funds Defined federal authorizations (e.g., HADD, NWPA) Transfer of interest in federal land Federal proponent	Any aspect of project construction, operation or decommissioning covered within the approved scope of assessment and/or federal/provincial agreement for EA process.
Harmful Alteration Disruption and Destruction of Habitat Authorization	Fisheries Act (Section 35)	Department of Fisheries and Oceans Canada	Required prior to harmful alteration, disruption or destruction of fish habitat. Cannot be issued until project is released from the federal environmental assessment process. Usually requires habitat compensation.	Alterations to surface streams, wetlands, etc. comprising fish habitat Dredging sediments Sub aqueous capping of sediments Infilling areas of the tar ponds and estuary Construction of cofferdams in the estuary Alterations to Tar Ponds shorelines Blasting near water
Navigable Waters Protection Act Authorization	Navigable Waters Protection Act	Transport Canada	Required prior to construction/obstruction within navigable waters. Cannot be issued until project is released from the federal environmental assessment process. Requires Transport Canada navigation assessment and advertising period.	Alteration to potentially navigable surface streams, wetlands as a result of rerouting, culvert installation etc. Dredging sediments Sub aqueous capping of sediments Infilling areas of the tar ponds and estuary Construction of coffer dams in the estuary
Disposal at Sea permit	Canadian Environmental Protection Act, Disposal at Sea Regulations	Environment Canada	Requires habitat assessment in areas not previously used for ocean disposal. In addition, the following information may also be	Movement /replacing/ sidecasting of sediments in the Tar Ponds Will be limited to North Pond

TABLE 4.1 Summary of Applicable Federal Approvals, Permits and Authorizations

Permit/Approval	Legislation	Responsible Government Department or Agency	Information	Potential Project Related Activities
			required: • Detailed physical, chemical, biological sediment characterization • Comparative assessment of alternatives to disposal • Comparative assessment of practical disposal options • Selection of a disposal site • Assessment of potential effects	Likely involve only dredged/excavated materials Likely involve relocation of materials to another location of the North Pond Activities associated with relocation and management of the sediments (e.g. dredging, transportation, management, etc.) Placement of cover material in a marine environment
Federal Mobile PCB Treatment and Destruction Regulations – Ministerial Authorization	Federal Mobile PCB Treatment and Destruction Regulations, Canadian Environmental Protection Act (CEPA)	Environment Canada	Authorization is required under Section 11 of the Regulations to operate a mobile PCB treatment or destruction system	Operation or testing of a mobile PCB treatment or destruction system
Notification – New Substances Notification Regulations	New Substances Notification Regulations, Canadian Environmental Protection Act (CEPA)	Environment Canada	Notification is required when chemicals or biotechnology new to Canada is imported to the Country	Import of chemicals or biotechnology new to Canada for use on site in bioremediation and/or treatment processes
Permit	Ozone Depleting Substances Regulations, Canadian Environmental Protection Act (CEPA)	Environment Canada		Import of chemicals or biotechnology new to Canada for use on site in bioremediation and/or treatment processes Production of ozone depleting substances during remediation works, including air emissions from treatment technologies
License - Federal Real Property	Federal Real Property Regulations, Federal Real Property Act	Transport Canada	The Act governs the conduct of federal government in respect to the acquisition, administration and disposition of real property. Under Section 4(2)(a) of the Regulations, the Minister may give or acquire the license for any use or occupation of real property	Physical activities that use or occupy Federal lands (or use or occupy the seabed within the boundaries of Sydney Harbour)

TABLE 4.2 Summary of Applicable Provincial Approvals, Permits and Authorizations

Permit/Approval	Legislation	Responsible Government Department or Agency	Information	Potential Project Related Activities
Environmental Assessment Approval	Environmental Assessment Regulations, Environment Act	NSEL	Environmental assessment approval may be required under the provincial Environmental Assessment Regulations. Although environmental assessment process for this Project is not yet determined, it is likely that a harmonized assessment process with the federal government will occur.	Any aspect of project construction, operation or decommissioning covered within the approved scope of assessment and/or federal/provincial agreement for EA process.
Industrial (Division V) Approval	Activities Designation Regulations and Approvals Procedure Regulations, Environment Act	NSEL	Required for activities falling under the Activities Designation Regulations. Approval required prior to construction, but cannot be issued until project is released from environmental assessment process.	Development of new pits/quarries for construction/fill material Other industrial activiites
Water (Division I) Approval	Activities Designation Regulations and Approvals Procedure Regulations, Environment Act	NSEL	Required for activities falling under the Activities Designation Regulations for alterations to watercourses (e.g., culvert installation) or wetland alterations (e.g., infilling). Approval required prior to construction, but cannot be issued until project is released from environmental assessment process.	Alterations to watercourses, including diversions, placement of culverts, bridges, infills, etc Infilling of wetlands
	Water and Wastewater Facility Regulations	NSEL		Any new or altered facility for treatment of water
	Sulphide Bearing Material Disposal Regulations	NSEL		Excavation and disposal of acid producing bedrock
	Petroleum Management Regulations	NSEL		Storage of fuels on-site for refuelling
Approval	Dangerous Goods Transportation Regulations, Nova Scotia Dangerous Good Transportation Act	Nova Scotia Department of Transportation and Public Works		Transportation of contaminated materials and dangerous goods to and from the site
Archaeological Research Permit	Nova Scotia Special Places Protection Act	Nova Scotia Museum	Permit required to conduct archaeological surveys.	Any activity that threatens or disturbs sites declared special places under the Act (archaeological/cultural/ecological)
Clearance under the Beaches Act	Beaches Act	Nova Scotia Department of Natural Resources	Provides clearance under the Beaches Act required for works seaward of the ordinary high water mark (OHWM).	Any sampling or remediation activity that takes place between the high and low tide mark of a marine or estuarine environment, including access by equipment

5.0 ENVIRONMENTAL PROTECTION PLANS

Environmental Protection Plans are compilations of the environmental protection measures, procedures, and mitigation measures related to a Project or specific activity or area of a Project. They are used during all Project stages, but mainly are used in the field as practical reference documents during construction, operation, and maintenance activities, to help ensure environmental commitments are met.

The EPPs, in essence, represent the environmental action plan for construction and operation activities.

5.1 OBJECTIVES AND APPROACH

The objectives of the Environmental Protection Plans will be as follows:

- The plans will provide a consolidation of environmental concerns identified in the EIA and any supporting and/or related requirements into one "document".
- The plans will provide a consolidation and outline of environmental protection and mitigation measures required to address environmental concerns.
- The plans will be used as a training tool for Project personnel. All personnel who may be involved in activities relating to any particular EPP will be trained on the protection measures prior to that activity being initiated.
- The plans will be written in clear language, so that they can be easily understood and implemented by all Project personnel.
- The EPPs will allow for changes and modifications as the Project progresses, in order to continually improve environmental protection practices.
- The EPPs can be used to assist with compliance monitoring.

The approach to development of the EPPs will involve:

- A review of all related documentation, such as EIA, Conditions of Approval, and any supporting documentation.
- Define the requirement for EPPs based on the review of the above information, including the rationale and intent of each EPP.
- Development of specific environmental protection measures to help ensure the environment is protected.
- Work with the Project design team to ensure proposed environmental protection measures can be coordinated with the project activities, and conversely, to ensure the design meets environmental protection expectations.
- Input into the plans will be sought from regulatory agencies.
- Update the EPPs as necessary.

5.2 SCHEDULE

Both the generic and the site-specific EPPs will be developed following the approval of the Environmental Impact Assessment for the Project. The EPPs will be finalized before the onset of any related Project activities. The plans must be prepared before Project activities commence to allow for training of appropriate personnel.

5.3 GENERAL PLANS

Generic EPPs include information about protection measures for certain types of activities or certain environmental consideration. For example, a generic EPP may be prepared for work near watercourses, and would include general information such as:

- obtain necessary permits prior to starting the work;
- install sediment fencing before starting any work;
- do not drive machinery into the watercourse; and
- ensure trees are felled away from the watercourse, etc.

These measures are meant to be generally applicable to work near any watercourse, for the example above. Typical sections of an EPP include: description of the activity and associated concerns, required permits and approvals, definition of responsible authority, reporting procedures, documentation requirements and mitigation measures.

Generic EPPs are developed for construction through to decommissioning of projects. Some generic EPPs, which are likely required for the Project, include but are not limited to:

- Clearing and grubbing
- Management of precipitation
- Cofferdam construction
- Work near watercourses
- Earth excavation
- Equipment maintenance and fuelling
- Product storage and handling
- Erosion and sediment control installation
- Erosion and sediment control maintenance
- Dust control
- Noise Control
- Work yard development

5.4 SITE-SPECIFIC ENVIRONMENTAL PROTECTION PLANS ("SSEPPS")

Site-specific EPPs (SSEPPs) include detailed information with respect to protection measures for a specific location. These site-specific measures are to be implemented in addition to the measures outlined in the generic protection plans. The SSEPPs will include the following elements:

- A map and/or figure illustrating and defining the area covered by the SSEPP.
- A brief description of the activities to be undertaken in the specific area.
- A description/listing of the environmental considerations for the specific area (i.e. what environmental features are causing a SSEPP to be required for this area, such as "the watercourse is known to have salmonids or species at risk present").
- A listing of any permits and approvals necessary to be in place before the work starts.

- Definition of the on-site responsible authority for environmental matters.
- Detailed mitigation measures for the work to be carried out within the limits of the SSEPP. These are typically shown as detailed, step-by-step procedures. For example, for work near a watercourse, a specific instruction may be: use flagging tape or snow fencing and appropriate signage to delineate the sensitive feature to the southeast of the work area before any work is undertaken, to ensure the area is not disturbed during construction.

The SSEPPs, which will be required for the Project, will be determined once the EIA for the Project has been completed, and they will be developed once project-specific details become known. It is expected that SSEPPs will be required for areas such as:

- Incinerator site
- Watercourse locations or diversions
- Wetlands locations
- Dredging sites
- Water Treatment Facilities
- Decontamination Operations
- Environmental Monitoring Activities
- Site Specific Health and Safety Plan

6.0 MONITORING

As part of the Project commitments to environmental protection, environmental monitoring will be conducted to ensure that any recommended mitigative measures and best management practices are implemented properly and that the result of these measures is "no significant environmental impact". Environmental monitoring programs will be classified into three areas: Environmental Effects Monitoring, Environmental Compliance Monitoring, and Post-construction Monitoring. In addition, as part of continual improvement processes and internal environmental management policies, it will be necessary to conduct periodic environmental inspections and audits of the Project to ensure that all environmental protection objectives are met. The results of these monitoring programs will be documented when complete.

6.1 ENVIRONMENTAL EFFECTS MONITORING ("EEM")

Environmental Effects Monitoring ("EEM") programs are intended to assess the accuracy of any predictions (concerning environmental impacts) made in the Environmental Impact Assessment for the Project, and to confirm these predictions, both the negative and positive. EEM programs are one of the many "early warning" tools to detect negative impacts on the environment from the Project, and allow for a review of the impacts and implementation of corrective actions, if they are required. EEM programs are typically carried-out over a period of several years.

6.1.1 Objectives and Approach

The objectives of a typical Environmental Effects Monitoring Program are as follows:

- Verify the actual environmental impacts as predicted in the EIA
- Verify the effectiveness of mitigation measures
- Verify the application of appropriate restoration measures (where applicable)
- Provide for early detection of undesirable conditions
- Assess the effects of the Project on environmental components (where applicable)

The approach to development of EEM programs will include:

- A review of all related documentation, such as EIA, Conditions of Approval, and any supporting documentation.
- Define the requirement for EEM programs based on the review of the above information, including rationale, intent, and monitoring parameters of each EEM program.
- Establishment of baselines by which changes in parameters associated with environmental features can be determined by comparing with the results obtained from the EEM program.
- Undertake the monitoring. This may include photographic and written records of conditions, other visual inspections/examinations, aerial observations, on-the-ground field surveys, and sampling (air, land, water). The type of monitoring will be dependent on the environmental features and associated predictions from the EIA.

Environmental Effects Monitoring plans would describe the rationale and objectives for each plan, the potential Project/environment interactions, and a detailed scope for the monitoring (for example detailed sampling procedures, and reporting requirements).
Some examples of typical EEM programs include:

- Groundwater Resources
- Plant Species of Special Status
- Surface water quality
- Air Quality
- Watercourses
- Wetlands

Specific programs will be recommended in the EIA and will be developed, prior to construction activities.

6.2 ENVIRONMENTAL COMPLIANCE MONITORING/INSPECTIONS

6.2.1 Objectives and Approach

A comprehensive monitoring and/or inspection program will be developed to verify the compliance of treatment technology utilized in the remediation of the tar ponds and coke ovens sites. These programs will be developed in association with various branches of the regulatory agencies and then implemented and maintained by the respective contractor, consultant or regulatory agency personnel as determined prior to the start of the activity.

6.2.2 Specific Monitoring Programs

It is anticipated that compliance monitoring programs can be subdivided into four (4) specific programs, which in turn can be applied to a variety of operations. These programs are summarized in the following sections. Several of these programs may involve pre-operational sampling and monitoring to create a baseline or background database which will then be used for comparison purposes during shutdown and decommissioning of the specific activity.

Sediment Removal Monitoring

Removal, treatment or stabilization of contaminated sediment identified during previous site assessment activities will be the primary focus of cleanup activities. Existing data and reports will be reviewed to provide estimates for the amount of contaminated sediment requiring various treatments and to identify where further sampling (if any) may be required to fully and accurately delineate volumes of contaminated sediment. Sampling and analysis of sediment will be conducted as needed during and after site excavation, but prior to backfilling, to assess the completeness and effectiveness of removal procedures. Sampling and analysis of treated materials will also be required during in situ and ex situ treatment activities to assess effectiveness.

Site Specific Target Levels ("SSTL's") have already been defined for the project and will be the criteria used to determine whether remediation activities are satisfactory. SSTLs exist for contaminants of concern within the sediment, surface water, groundwater or soils of the North and South Ponds and the Coke Ovens site.

Noise Monitoring

Periodic noise monitoring in the vicinity of the selected treatment technologies may be performed in order to ensure compliance with the Guideline for Environmental Noise

Measurement and Assessment (Nova Scotia Department of Environment 1998), operating permits and the local or regional noise control by-law. The intent of the monitoring program is to ensure that operating equipment does not produce measurable changes to the environmental sound exposure at the noise monitoring sites. Noise minimization techniques (i.e.; enclosures, landscaping, noise barriers, silencers) may need to be implemented to ensure impacts (if any) are properly managed.

Effluent Monitoring

Prior to removal, release or discharge from a site, all effluent streams (ie; wastewater, incinerated materials, stack emissions,) will require analytical testing and approval. The type of analytical testing will be entirely dependent on the nature of the effluent to be released or discharged.

Incinerated solids will be sampled on a batch basis to verify the PCB destruction criteria are met. Testing will also be completed for polychlorinated dibenzo-p-dioxins ("PCDD's") and polychlorinated dibenzofurans ("PCDF's") and heavy metals in the incinerated soils.

Liquid effluents are generally anticipated to consist of incinerator process liquids, decontamination water from site run-off collection and equipment washing (decontamination) activities and treated wastewater from various water treatment operations. Process liquids consist of boiler blowdown water, which can generally be discharged to the sanitary sewer after testing and brine from the air pollution control system scrubber which can be transported for commercial use or discharged to the environment, depending on analytical results and regulatory approvals. Liquid effluents will be tested for sewer use disposal parameters, disposal at sea parameters, PCBs, PCDDs and PCDFs as applicable.

Gaseous effluent from the stack will be tested through a series of stack tests. The main requirement of stack testing is to extract exhaust gas samples from the incinerator stack and then to perform laboratory analysis on the extracts. The scientific requirements for stack testing are very rigorous which makes stack testing a specialized and expensive monitoring procedure.

An extensive list of organic and inorganic contaminants will also be analyzed from the stack gas extracts including PCBs, PCDDs, PCDFs, particulates, hydrochloric acid, chlorobenzenes, volatile organic compounds ("VOCs"), polycyclic aromatic hydrocarbons, chlorophenols and heavy metals.

Also during stack testing the PCB and PAH waste materials fed into the incinerator will be regularly sampled. This allows the proper calculation of the incinerator performance standard known as the Destruction Removal Efficiency ("DRE"). The minimum DRE requirement is 99.9999% for PCBs and 99.99% for PAHs.

The selected technology vendor will be required to prepare and submit a Quality Assurance Project Plan, which will document the details of the technology operation and establish the operating parameters for the duration of the project under various scenarios and waste feed characteristics.

Process Monitoring

Operating conditions of the various treatment technologies that are selected will be recorded by the operator as a condition of their permit or certificate of approval. The type and level of detail of information to be collected and reviewed will be the subject of the approval process and will depend on the characteristics of the proposed technology.

As an example, operating conditions for an incinerator can be continuously recorded through a data acquisition and control computer that is programmed to comply with operational requirements stipulated by the regulatory agencies. Data such as minimum operating temperatures, carbon monoxide levels, carbon dioxide levels, maximum allowable feed rates and proper functioning of automatic waste feed shut offs can be tracked, recorded and monitored. Routine inspections of the system by designated regulatory inspectors will ensure that treatment technology is operating as designed and within the stipulated parameters of its' operational permit.

Decontamination Monitoring

Prior to leaving a project site or a contaminated area, any equipment that contacted contaminated material or potentially contacted contaminated material will require testing to ensure it is either clean or has been properly decontaminated. Decontamination monitoring will cover media such as contractors equipment, incinerated materials, treated water, brine, sediment, concrete, steel surfaces, etc.

Sampling protocols will be developed for application by designated project staff to ensure defendable analytical results are obtained which in turn will allow decisions to be made on whether an item or material is suitable for release from the project site. All sampling protocols will be clearly written and available for review and application as needed. Designated employees responsible for sample collection, sample preparation, completion of chain of custody forms and transportation of samples to analytical laboratories will undergo appropriate training prior to beginning work on a project.

It is anticipated that an extensive database will be required to record, monitor and manage the large amount of samples that are typically collected during projects of the type proposed for Muggah Creek. In conjunction with the EMP for the MCRP a separate Environmental Monitoring Manual will be developed specifically to provide guidance, procedures and protocols for the wide variety of sampling events and media that the MCRP will generate.

6.3 ENVIRONMENTAL INSPECTIONS AND QA/QC

Compliance with the large number of applicable environmental legislative requirements will be of utmost importance on a project of this size, scope and duration. It is anticipated that the Provincial and Federal governments may require full time regulatory inspectors on-site during critical operational activities to ensure full compliance with conditions stipulated in approval permits. As operations become more routine, full time presence can be cut back to random unannounced inspections.

Inspectors will need to be assigned, trained and mobilized to the respective site(s) and provided with the means to carry out their regulatory requirements. Several technologies such as incineration and water treatment are likely to operate 24 hours per day, 7 days per week necessitating the use of shifts and a team of regulatory inspectors to monitor ongoing operations. Overlap in shifts will likely need to be arranged to ensure a proper transfer of notes, information and reports from the outgoing inspector to the incoming inspector.

6.4 ENVIRONMENTAL AUDITS

Suitably qualified external consultants should also conduct environmental audits of the operations at least every two (2) years. This will ensure a consistent environmental management program for the site.

An Environmental Audit is an objective evaluation of how well an organization's management and practices are performing in meeting the goal of safeguarding the environment. It facilitates management control of environmental policies and provides an assessment of compliance with internal policies of the Proponents. The purpose of the Environmental Audit is to:

- Identify key impacts of the Project on the environment.
- Provide a true and factual assessment of the Project's operations with regard to environmental policies.
- Document the environmental status of the Company's operations.
- Act as a feedback mechanism to determine where improvements are required (e.g., poor operating and maintenance practices, opportunities for cost reduction and improvements).
- Identify risk exposures with regard to environmental issues.
- Improve employee awareness with regard to environmental issues.

The auditors conducting the work shall be selected so as to ensure the objectivity and impartiality of the audit. The Auditors shall be guided in their work by existing international and national standards as well as internal policies of the Proponents. The Auditors should be familiar with industry standards and practices relating to remediation projects.

7.0 CONTINGENCY AND EMERGENCY RESPONSE PLANNING

7.1 INTRODUCTION AND PURPOSE

This section outlines the commitments that have been established by the government partners regarding Emergency Response and Contingency Planning including the format, level of detail and the necessary technical content requirements for the preparation and submission of mandatory Emergency Preparedness and Response ("EPR") plans.

Each contractor/consultant will be required to develop and implement a set of project specific policies and procedures to address operational emergencies including both man-made and natural events. The hazard analysis shall include but not be limited by events such as:

- Fires;
- Explosions;
- Spills;
- Operational upsets;
- Equipment malfunction(s);
- Severe weather;
- Power outages; and,
- Transportation accidents.

The purpose of any emergency plan is to provide the management framework including the technical and financial decision making, authorization, and controls to provide an effective and coordinated response to an identified hazard or risk.

An appropriate emergency plan will:

- ensure the safety of workers, emergency responders and the general public;
- reduce and minimize property damage;
- reduce the magnitude of any related environmental impacts;
- provide an appropriate set of procedures to ensure that proper emergency and remedial actions are undertaken quickly and effectively;
- reduce recovery time and costs; and
- promote confidence in response personnel, project management team contactors and or consultants and the general public.

Although every emergency is unique, remedial operations have several common elements including the following:

- Prevention;
- Preparedness;
- Response; and
- Recovery.

Each contingency plan will be consistent with the framework to be established under the Master EPR for the project. All plans will be required to document and communicate reportable incidents and establish clear callout and notification procedures for all relevant agencies. The plan will also establish roles and responsibilities for the key personnel identified within the plan.

7.2 HAZARD ANALYSIS AND RISK DETERMINATION

All contractors/consultants will be required to identify the risk associated with each operational component under their direction and develop appropriate response and mitigation strategies to meet the objectives of the overall contingency plan.

7.3 EMERGENCY PLANNING LEGISLATION

The following table outlines the legislation that establishes the framework for environmental emergency planning and will be applied where applicable within the scope of the project.

7.4 MINIMUM PLANNING REQUIREMENTS

All plans shall be developed in accordance with the Nova Scotia Department of Environment and Labour Contingency Planning Guidelines and/or the October 2003 document - CAN/CSA – Z731-03 Emergency Preparedness and Response for Industry. EPR's will include as a minimum the following key elements associated with managing an emergency response.

- A senior level statement committing to implement and maintain the contingency plan;
- Identification of the physical and chemical properties and characteristics of the substance being handled; where they are located in relation to the surrounding area; and how they are stored, handled or transported;
- Assessments of any reasonable foreseeable emergency scenarios associated with release of the substance, including both on-site and off-site, which could adversely affect public health and safety, the environment, and property;
- A description of the measures to be used to prevent, prepare for, respond to and recover from any emergency scenarios identified above;
- A description of the roles and responsibilities of key personnel and responders during an emergency;
- The identification of training requirements for key personnel and responders;
- Accurate contact lists for emergency resource personnel and equipment;
- Provision for ensuring that the plan is improved on a continual basis (i.e. updates, exercises, debriefings);
- Measures to be taken to notify members of the public who may be adversely affected by the emergency; and
- The requirement to document and communicate reportable incidents and establish clear callout and notification procedures for all relevant agencies.

TABLE 7.1 Applicable Emergency Response Legislation

Legislation	Requirements
Federal	
Canadian Environmental Protection Act (CEPA 1999) Requirements for Environmental Emergency Plans — CEPA 1999 Subsection 200(1)	The Governor in Council may, on the recommendation of the Minister and after the Committee is given an opportunity to provide its advice to the Minister under section 6, make regulations a) establishing a list of substances that, if they enter the environment as a result of an environmental emergency, i) have or may have an immediate or long-term harmful effect on the environment or its biological diversity, ii) constitute or may constitute a danger to the environment on which human life depends, or iii) constitute or may constitute a danger in Canada to human life or health; b) prescribing, in respect of a substance on the list established under paragraph (a), a minimum quantity; c) respecting the identification of the places in Canada where a substance referred to in paragraph (a), in any quantity or in the quantity prescribed for that substance under paragraph (b), is located and requiring notification to the Minister of those places; d) respecting the prevention of, preparedness for, response to and recovery from an environmental emergency in respect of a substance; e) respecting the notification and reporting of an environmental emergency; f) respecting the notification and reporting of the measures taken i) to prevent the environmental emergency, or ii) to repair, reduce or mitigate any negative effects on the environment or human life or health that result from the environmental emergency or that may reasonably be expected to result from it; g) respecting the implementation of international agreements entered into by Canada in relation to environmental emergencies; and h) respecting any other matter necessary for the purposes of this Part.
Transportation of Dangerous Goods Act	Requirement for an Emergency Response Assistance Plan (ERAP) (1) A person who offers for transport or imports a consignment of dangerous goods must have an approved emergency response assistance plan when the quantity of dangerous goods exceeds the ERAP limit referred to in subsection (4). Subsection (1) deals with one consignment of dangerous goods and one transport event. If the

TABLE 7.1 Applicable Emergency Response Legislation

Legislation	Requirements
	quantity of dangerous goods in the consignment exceeds the ERAP limit an ERAP is required. Subsection (2) deals with an accumulation of consignments. (2) A person who offers for transport or imports more than one consignment of dangerous goods at the same time must have an approved ERAP if the consignments are in more than one large means of containment required by Part 5, Means of Containment, and the total quantity of dangerous goods in all the required large means of containment exceeds the ERAP limit referred to in subsection (4) . Under subsection (2) , an accumulation of large tubes making up a standard hydrogen tube trailer would need an ERAP but an accumulation of small camping gas cylinders would not need an ERAP. Only dangerous goods in consignments that require a large means of containment are counted. (3) A person who offers for transport or imports, in a road vehicle or railway vehicle, dangerous goods included in any one of the following classes must have an approved ERAP if the total quantity of any one of those dangerous goods offered for transport or imported by that person in the road vehicle or railway vehicle exceeds the corresponding ERAP limit referred to in subsection (4) for those dangerous goods: (a) Class 1, Explosives; (b) Class 3, Flammable Liquids, with a subsidiary class of Class 6.1, Toxic Substances; (c) Class 4, Flammable Solids, Substances Liable to Spontaneous Combustion; Substances That on Contact with Water Emit Flammable Gases (Water reactive Substances); (d) Class 5.2, Organic Peroxides, that are Type B or Type C; and (e) Class 6.1, Toxic Substances, that are included in Packing Group I. (4) A quantity of dangerous goods exceeds the ERAP limit if the dangerous goods have an index number in column 7 of Schedule 1 and (a) if a solid, have a mass that is greater than the index number when that number is expressed in kilograms; (b) if a liquid, have a volume that is greater than the index number when that number is expressed in litres; (c) if a gas, including a gas in a liquefied form, are contained in one means of containment that has a water capacity greater than the index number when that number is expressed in litres; or (d) if an explosive in a road vehicle or railway vehicle, have a net explosives quantity greater than the index number when that number is expressed in kilograms. *If there is no index number set out in column 7 of Schedule 1, an ERAP is not required.* (5) Despite subsections (1) , (2) and (3) , a person other than a manufacturer or producer is not required to have an approved ERAP if that person offers for transport or imports one or more consignments of dangerous goods for which an ERAP is required on behalf of another person who already has an approved ERAP for the dangerous goods.
Provincial	
Environment Act - 78(2)(h)	The Minister may direct a person responsible for dangerous goods or waste dangerous goods to prepare and submit to the Minister a written contingency plan respecting the handling of dangerous goods or waste dangerous goods.

TABLE 7.1 Applicable Emergency Response Legislation

Legislation	Requirements
Dangerous Goods Management Regulations – Sections 10(1) and 10(2)	every person responsible for a storage facility may require contingency plans to be approved before allowing dangerous goods or waste dangerous goods to be stored if they have the following: (a) a combined capacity of 2000 kg of dangerous goods or waste dangerous goods (b) a combined capacity of 2000 l of dangerous goods or waste dangerous goods, or (c) waste dangerous goods in quantities greater than those listed in Column II of Schedule "A" or "B" shall have contingency plans respecting (i) fires or other emergencies; and (ii) discharges, emissions, escapes, leaks or spills of dangerous goods or waste dangerous goods.
PCB Management Regulations	Fire protection and emergency procedures are required for an owner, operator, or person responsible for a storage site and this includes an emergency procedures plan, approved by an Administrator, which must be in effect, and all employees must be trained in its application. A copy of the plan must also be deposited at (i) the local fire department, (ii) the storage site, and (iii) the place of business of the owner, operator, or the person responsible;
Other Legislative Requirements	Depending on the nature of activities and technology implemented on the MCRP several other legislative requirements will also need to be considered from the perspective of EPR planning. These include, but are not limited to: • Petroleum Management Regulations No person shall operate a bulk plant without having in place a contingency plan approved by an Administrator or an inspector. • Pesticide Regulations The Minister or an Administrator may require contingency plans respecting a release of a pesticide to be prepared for approval by the Minister or the Administrator by a person who holds a Class IX certificate of qualification or by an approval holder who applies a commercial class or restricted class pesticide. • Approval Procedure Regulations Unless specified otherwise in an application form or by the Minister or an Administrator under subsection (2), an application shall be accompanied by the following information: (s) contingency plans to deal with any reasonably foreseeable sudden or gradual release of a substance, which is likely to have a significant adverse effect.

8.0 TRAINING AND EDUCATION

8.1 OBJECTIVES AND APPROACH

Awareness of Project health, safety and environmental policies and procedures is crucial to the protection of worker, public health and safety and the environment. All personnel working on the Project must be familiar with the EMP and applicable environmental protection documents that will be prepared during the course of this Project. Awareness of environmental commitments and obligations, including compliance with terms and conditions of approval are essential to the success of the Project.

The following sections outline anticipated requirements for worker training and education required to support the various other aspects of the EMP and ensure a high level of environmental protection and compliance with legal requirements. This information is presented at a preliminary level for initial planning purposes. It will be refined through the environmental approval process and included in a revised and updated EMP once all the specific education and training components have been determined.

8.2 INSPECTION STAFF TRAINING AND CERTIFICATION REQUIREMENTS

Following regulatory approval, but prior to commencement of work, an environmental inspection team will be hired to monitor the environmental aspects of the Project. This team will consist of trained and qualified individuals that may include biologists, technicians, and engineers. The focus of each inspector in the field will be directly related to his/her expertise and experience on similar projects. Some senior inspectors will be assigned special roles with regard to QA/QC, supervision and auditing of environmental procedures including the provisions of the EMP.

Inspection Staff will receive worker orientation training and other specific education programs described in Section 8.4. In addition, Inspection Staff will be trained, depending on their areas of responsibility, in inspection and monitoring programs specific to this Project. Section 6 outlines potential compliance monitoring programs to be implemented for the Project.

8.3 WORKER ORIENTATION TRAINING

To ensure that personnel are informed of the environmental requirements and issues of special concern, an Environmental Orientation Training Program will be established. All personnel will receive orientation training to familiarize themselves with the Project components and site locations, as well as the applicable environmental protection procedures and commitments.

The training program will revolve around the EMP and environmental protection plans. These documents, based on input from the environmental assessment report and conditions of Project approval, will identify sensitive environmental features in the study area as well as general and specific protection procedures to be implemented during Project activities.

The Safety, Health and Environmental Coordinator will be responsible for providing a program to ensure that all personnel have received orientation training prior to commencement of work. A written record will be kept of individuals who have received orientation training. Updates to the EMP and other applicable procedures subsequent to the orientation training session will be communicated through internal communication procedures as described in Section 9 of this document.

8.4 SPECIFIC EDUCATION PROGRAMS

In addition to the general worker orientation, specific education programs may also be required, depending on an individual's assigned role and area of responsibility. The Project Manager must maintain records of all the training undertaken by Project staff. The following summarizes other anticipated education programs that may be required as the Project proceeds.

8.4.1 Health and Safety Training

All personnel working on the Project will receive health and safety training to include, but not be limited to:

- Health and Safety Plan;
- Contingency and Emergency Response Plan;
- Safe Work Practices;
- Personal Protective Equipment Use;
- 40 Hour HAZWOPER
- Confined Space Entry Awareness
- Fall Arrest Training
- Emergency Contact Information;
- Hazard Identification;
- WHMIS; and
- Transportation of Dangerous Goods (as applicable).

8.4.2 Treatment Technology Processes

Personnel involved in treatment technology processes will be certified as required; the Safety, Health and Environmental Coordinator will ensure these certifications are up to date. These personnel will receive training on Project-specific treatment technologies and operations.

8.4.3 Waste Management

All personnel will receive training on waste management as part of the Worker Orientation Program. However, personnel responsible for handling and transporting wastes will require specific training related to the Transport of Dangerous Goods. Waste haulers will be licensed contractors, knowledgeable of appropriate handling and disposal procedures for domestic and hazardous wastes.

9.0 COMMUNICATIONS AND REPORTING

9.1 OBJECTIVES AND APPROACH

Part of the success of the Project will require clear lines of reporting, and communication, both within the Project and externally. Specific guidelines shall be developed that outline mechanisms for communication among Project personnel, as well as means of engaging and responding to concerns or comments from the public.

9.2 DOCUMENT CONTROL

In order for the proper implementation of environmental protection measures, it is essential that all Project personnel have access to the most current documentation, including any revisions to the EPPs. The responsibility for ensuring that EPP copy holders have the most recent version resides with both supervisory staff and Project personnel. Maintenance of this EMP will be the responsibility of the Project Manager or designate to ensure the most current and comprehensive version of this EMP as well as SSEPPs, to Project staff, applicable regulating agency representatives, stakeholders, interested parties and others as listed on a Project distribution list. The following outline the various responsibilities of the Proponents:

- provide a training course for relevant Project personnel including Contractors, to ensure proper implementation of this document;
- distribute copies of the EMP and SSEPPs to appropriate locations and Project personnel;
- review EMP/EPP revision requests in a timely manner;
- issue approved revision pages to the EMP/EPP to control copy holders; and
- conduct a full review of the contents of the EPP on a periodic basis to ensure that recommended mitigative measures and Best Management Practices (BMPs) are current and comprehensive.

The Safety, Health and Environment Coordinator shall:

- Review and approve revision requests;
- Conduct a review of the EPP on an as needed basis;
- Ensure that revisions are distributed to EPP holders;
- Maintain Document Control;
- Ensure that EPP holders and their staff are familiar with the EPP and its procedures;

EPP Holders shall:

- Keep copy current and ensure that all revisions are entered on the revision control record;
- Familiarize themselves and their personnel with the EPP and any revisions; and
- Initiate changes to improve the quality of the plan.

EPP holders and readers may initiate proposed revisions by forwarding recommended revisions to the Coordinator on a Revision Request Initiation Form. The Coordinator and Project Manager must approve the revision request. When the Coordinator obtains the approved Revision, it will be issued to all EPP Holders. Each revision will be accompanied by a Control Sheet that:

- Provides the revision instructions; and
- Lists the sections being superseded.

9.3 PUBLIC INFORMATION AND COMMUNICATIONS

The Public Information Program will be developed to inform the public and stakeholders about the Project and invite the parties to take part in the process at appropriate stages of the Project. Local media will be used to convey information to stakeholders and others who express an interest in the process. Media interviews and other public representation will be referred to the STPA Project Manager for determining the appropriate response and responder.

All issues will be documented, tracked and channelled to the appropriate proponent or project personnel for resolution. The issues management process enables individuals and groups to raise issues and concerns and have them addressed in a systematic manner. Issues will be periodically reviewed to determine if closure has been reached. Information that is collected may include:

- Stakeholder/Personal Information (e.g. organization's name, address, person contacted).
- Form of Communication (e.g. e-mail, media, workshop, group meeting, individual meeting, telephone, letter).
- Primary Purpose of Contact (e.g. compliance monitoring, data collection, regulatory, on-going consultation).
- Relevant location.
- Stakeholder Category (e.g. Academic/Institute, Community Group, Aboriginal Community).
- Stakeholder sector (e.g. Environment, Fishery, Social).
- Stakeholder issues (e.g. air quality, employment, environment, water quality, socio-economic effects).
- Follow-up required.

9.4 REPORTING

As part of the reporting mechanism for the Project, procedures will be developed for preparing an environmental report covering the results of monitoring with the agreed environmental standards. A compliance audit report should also be included in the Project files.

The Project will also require the development of procedures for handling and recording environmental incidents and near misses. This will include the response and follow up to complaints, an investigation of the root cause and recommendations to prevent reoccurrence.

9.4.1 Reporting Procedures

A number of environmental reports will be generated annually as part of the Project. It will be necessary to develop specific reporting procedures for these various reports to ensure that all relevant information is being forwarded to the appropriate parties, in an appropriate time frame. These procedures will be developed for:

- Compliance monitoring as outlined in permits and approvals
- Reportable environmental incidents, as defined in Project EPPs, regulations, permits and approvals
- Project defined environmental inspections

9.4.2 Compliance/Regulatory Reporting

The environmental field inspection activities shall be documented on standardized forms to provide consistency in reporting. These forms shall be generated and updated as necessary to reflect specific site conditions and changes in work activities or environmental requirements. In addition to written reports, photographs shall also be used to document environmental compliance. The STPA will be responsible for assigning an individual(s) for the logging and filing of all environmental documentation.

An action items list shall be maintained to track the compliance inspection and reporting aspects of the project. As action items are identified, they shall be added to the list along with:

- The date the action item was issued;
- The party responsible for completing the action item;
- The data that completion is due; and
- Any necessary documentation or special conditions to be met.